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TELEGRAPHIC COMMUNICATION BETWEEN ISLANDS AND THE MAINLAND.

THE important and urgent question of establishing direct telegraphic communication between the mainland and mid-ocean islands and lighthouses, although frequently put aside by the Treasury or the Post Office, is by no means allowed to slumber by those most interested in securing this facility. The leading men in most of our seaports are steadily following up the subject, and a recent conference has given to their efforts a new impetus which can hardly fail to produce substantial result. A great want long felt, both as to convenience and safety by shipowners, has been a signalling station off the north coast of Ireland by which incoming or outcoming vessels could communicate with the mainland when in distress, or for business purposes. Various plans have been tried, and with different points, but they have all failed, while the traffic through the North Channel has continued to grow. From Rathlin Head pigeons had been tried, and that method failing experiments were made from Malin Head, with practically the same result. Some signalling can be effected with that point, but only in fine, clear weather, and the position of the head is too dangerous for vessels to approach near enough. After these failures Tory Island was selected and pigeons were again used, but it was found that these birds would not leave the island in stormy weather, when direct communication would most pressingly be required. This island is, however, the safest and most convenient position for a signalling station, and strenuous efforts are being made to connect it by telegraph wire with the mainland. The Duke of Abercorn being in Glasgow at the Exhibition, a number of merchants and shipowners interviewed him with a view to gaining his support and co-operation respecting this subject. The state of the case having been laid before him, the Duke described the object as a very important one, and one which no government but our own would have failed to carry out long ago. He would gladly exercise any influence he possessed, but he suggested that the most effective process was a combined representation by Glasgow, Liverpool, Londonderry and other mercantile centres, backed up by the views of ship captains. Telegraphic communication with the north-west coast of Donegal was urgently needed, but the great difficulty he feared would be the Treasury, who, whatever the Admiralty or the Post Office might say, would probably demur to the expense. Therefore he would recommend a strong representation to the Prime Minister as a first step. Mr. McNeil, of Messrs. A. and A. Laird & Co., described the various devices that had been resorted to in the absence of a cable, and quoted the opinion of several commanders of ships in support of the cause. Among other things he advanced the view that if this telegraph were established, passengers by Atlantic steamers would so largely use it that it would soon pay itself and yield a profit; and following up this point he suggested that, if necessary, the shipowners concerned should guarantee the Government 3 per cent. on the outlay. Several captains stated their conviction of the necessity for the proposed cable, on the ground mainly of safety to shipping, and the conference ended, it being generally understood that fresh efforts on the lines then suggested should be made. The first definite outcome was that on Tuesday last week Sir E. Watkin asked the Secretary to the Admiralty what further steps, if any, had been taken, for the protection of life and property, towards connecting the lighthouse on Tory Island with the mainland by electric cable. Sir M. H. Beach replied that he had reason to believe that Lloyds were now in communication with the Postmaster-General on the subject, and there was a bill dealing with the matter now before Parliament. This Lloyds' Bill we believe only incidentally touches the subject, but it may be made the basis of something more effective.

THE FRENCH ELECTRIC LIGHTING ACT.

THE *Journal Officiel* of the 16th June ultimo publishes the decree relating to the supervision and control of electric light installations, together with the report of the Minister of Finance upon the conditions expressed in the said decree.

To Englishmen there is generally ascribed a feeling of patriotism (or egotism ?) which convinces them of the superiority of all things British. Now without agreeing in its integrity with such a feeling, we believe that there are many matters in which we can justly claim to be on a level with, if not even ahead of, our neighbours; we more particularly refer to legislation upon electric lighting enterprise.

Whatever venality may be laid at the door of our local authorities, it would be a difficult, not to say an expensive, procedure to induce the whole of a local board to regard a certain affair in the required light, putting on one side the merits of the scheme, and the controlling power of the Board of Trade. In the case of a French electric lighting undertaking, the conditions would appear to be, in the preliminary as well as later stages, such as to open an easy road for bribery and personal favouritism, and not only is the possibility of corruption invited, but it would be actually difficult for the most straightforward official to escape calumny, or suspicion of venality. We speak on this subject with some small acquaintance with the matter, but it is by no means a secret that the laws which govern electric lighting, and indeed many other industries, throw very serious temptations in the paths of French officials. It would be absurd for Englishmen to pose as being more immaculate than their neighbours, more especially in view of the revelations which our Metropolitan Board of Works inquiry has just brought to light, but as a rule our public functionaries have less motive, as well as fewer opportunities, for betraying their respective trusts.

Among the stipulations imposed by the decree under notice, we observe that electric light conductors must be covered with some insulating material when they are carried on the same supports with naked telegraph or telephone wires, when they cross such wires, when they pass within a distance of two metres from them, or when they come within one metre of gas or water pipes.

It would appear that so long as a certain voltage (60 volts for alternating and 500 volts for continuous currents) is not exceeded, but little control is exerted over complete installations carried out on one and the same premises, the preliminary formalities, in these cases, being dispensed with. The safety of the workmen is particularly cared for, it being enacted that they are to wear India-rubber gloves, and on no account to carry bare wires in their hands. Happy workmen, that the Government should watch over their welfare with such paternal solicitude! Naked wires are permitted in houses either openly or boxed up, under certain restrictions, such as the crossing of floors, ceilings and walls, when they must be covered with some insulating material.

The questions as to whether the conductors fulfil the necessary measures of safety, such as position, insulation, diameters of wires, loads on circuits, &c., and whether the installation as a whole complies with the decree, are left to the judgment of the district engineers of posts and telegraphs, who in this matter are under the authority of the prefect of the department.

IN the latest issue to hand of the *Electrical World* we notice a paper by Mr. Thos. D. Lockwood, the well known American electrician, entitled, "What shall we read?—Part I." The writer thinks that no library, however complete, can take the place of the electrical newspaper, and, in addition to recommending those published in his own country, he is good enough to suggest that his fellow electricians should also read the English technical press. Unless a man is a linguist he does not advise a subscription to a paper printed in a foreign language, because all the subjects of interest are generally to be found translated in the home journals. Mr. Lockwood has assumed a number of classes of readers, and to each of these he recommends a dozen books which he thinks would be most fitted for the ends his imaginary classes have in view.

CLASS A is intended for those who are starting with the intention of succeeding in the profession of electrical engineering, but who have no special education to that end, and who, moreover, have no money to spare. Amongst the authors enumerated we notice that six are English, two French, and only one American, the volumes from this side being S. P. Thompson's "Elementary lessons in Electricity and Magnetism," and "Dynamo Electric Machinery," Sprague's "Electricity—theory—sources and applications," Jenkin's "Electricity and Magnetism," Bromley Holmes's "Practical Electric Lighting," Gore's "Art of Electro-Metallurgy," and Gordon's "Physical Treatise on Electricity and Magnetism." Mr. Lockwood advises the class of readers here addressed to look upon their books as tools which they must have, or as so much money invested which is by-and-by to bring back a handsome return. Such advice is practical, to the point, and cannot be gainsaid.

CLASS B applies to telegraph operators wishing to acquire knowledge which their daily work cannot teach them, and which may fit them for better work. Of the books which are thought most suitable for this class of reader the majority, as might have been expected, are from the pens of American authors, only our S. P. Thompson, Preece and Sivewright, Culley, and Sprague being quoted. We may perhaps remark here that it is curious to note that although Mr. Lockwood is careful to credit Preece and Sivewright with giving a correct idea of telegraphy from an English point of view, and Culley as being a particularly clear writer on induction and cable testing, he ignores Kempe's "Handbook of Electrical Testing" altogether, although this is thought indispensable to telegraph men all the world over, and is rightly considered to be the best book of its kind in any language.

CLASS C, which concludes the author's first article, gives a list of books mainly intended for those who study electricity and magnetism from either the historical or archæological point of view, and he makes special reference to Mr. Fahie's "History of Telegraphy up to 1837," the descriptions of early telegraphs contained in this volume being particularly interesting. He also refers to the articles on electricity in the last three editions of the *Encyclopædia Britannica* as being perfect mines of wealth. We have no doubt that if those who, from force of circumstances, are obliged to be discriminative in their choice of books, and who want to know just what selection to make to suit their special avocations, will take advantage of Mr. Lockwood's well meant advice, they will have no cause to regret making the purchases to which he incites them.

A CORRESPONDENT who writes to us this week on the subject of running the Underground Railway trains electrically appears to think that the conductor system presents but little difficulty. We ourselves have already expressed the opinion that we did not deem it an impossibility to substitute electricity for steam, so long as secondary batteries are not carried on the locomotive; and, possibly, the time is not far distant when this great change will be wrought. We, however, should be quite contented to see the tramlines of this country successfully operated by electrical traction before the attempt is made to apply it to such stupendous undertakings as that mentioned above. The eminently practical article on p. 7, by Mr. C. P. Elieson, who admittedly has had great experience with the numerous little obstacles, not very serious, perhaps, in themselves, but difficult to foresee or to obviate when in combination, may perhaps act as a check upon those too enthusiastic individuals who wish to use the name "electricity" as a lever for lifting the earth, forgetting in their flights of fancy that the fulcrum has yet to be found.

WHAT difference in the total working cost of central electric lighting stations, and in the dividends which we hope will be forthcoming to shareholders, would a reduction of 16 to 30 per cent. in fuel consumption represent? This appears to us to be such an important question that we should be glad to learn whether any of our readers have had any practical experience in the working of Gosling's patent fuel economiser.

Messrs. Gosling & Co. are engineers of Hadleigh, Suffolk, and they claim, and show testimonials in support of the statement, that the use of their apparatus, which can be made part and parcel of a boiler in less than an hour, effects a great saving in fuel. Mr. Newby, the engineer to the Gas Light and Coke Company, reports a reduction of 29 per cent. in the fuel used after adopting Gosling's process, which is now applied to no less than 61 of the company's boilers. Other users of steam power testify to a great saving of coal, so assuredly this invention must be well worth investigation on the part of electric lighting engineers, as the apparatus can be applied to Cornish, Lancashire, or any horizontal fluid boiler, with or without "Galloway" tubes. We should be very pleased to learn more of this reducer of the coal bill.

SINCE penning our reply to Mr. Sharman's letter, a communication with respect to a gentleman who parted with 10s. 6d. for a copy of the articles of association of the B.A. of Medical Electricians, has been placed in our hands. The following extract will be read with interest, and may be profitably compared wtth our last week's leaderette and the letter of the worthy secretary of this august body. "You will please notice that all the present members are on the *electropathic staff*, at least I am certain of all except two." Now, if this does not exactly coincide with the information which we gratuitously gave to the confiding British public in our last issue, our wits must be wool-gathering. Mr. Sharman will have to prepare a more convincing retort than that with which he now favours us before he can throw dust into the eyes of our readers, as our correspondence columns most clearly show.

WE have seen a very large number of press notices within the past few weeks of the Phœnix Fire Office rules for electric lighting, but none which could be so gratifying to Mr. Musgrave Heaphy as that which appeared in the *Devon Weekly Times* of the 22nd ult. That clever journal has ascertained that "a useful force of electricity is also a subtle one," and that "it has its secrets and these can only be mastered by years of intelligent and patient study." These are undoubted facts, even if they are not expressed in language which would commend itself to an electrician. But the paragraph goes on: "In Mr. Musgrave Heaphy, C.E., the Phœnix Fire Office found an electrician to whom electricity is as well known as are the natures and dispositions of children by observant parents." Now this sentence is a complete puzzle to us. Was the writer aware of the actual circumstances and inspired by a fine sense of sarcasm? Or is this but the outcome of a simple, trustful faith on the part of an ingenuous Devonshire journalist? And what does he mean by his analogue? Does he suggest that Mr. Musgrave Heaphy is the father of electricity, and, more fortunate than many another, knows his own child? And does he really believe that even the most observant of parents have sufficient wisdom and penetration to fathom the interminable depths of the infantile mind? We trust that it will not be too great a shock to our provincial friend to learn that Mr. Musgrave Heaphy, with his proverbial modesty, disclaims being an electrician at all.

IT has often been said that electric lighting companies will eventually become absorbed by mechanical engineering establishments, and this state of things may eventually come to pass, the number of electrical companies pure and simple being now very small. Another danger now threatens the few that are still left to us, and may even affect the whole electric lighting industry if something is not at once done to check it. In the *Norwood Press and Dulwich Advertiser* of June 2nd appeared the following business notice, which, even if looked upon from a literary standpoint only, is a treasure deserving of greater publicity than the modest corner in a South London weekly could ever afford:—

> T. Hall, late of Crown Hill, now of 42, Romany Road, is still open to supply the electric light, he having travelled with the same many years; also dealer in furniture, &c. He is also open to deal just and right with all customers in both branches, from his curiosity shop by seeing him on his round.

Is it not more than probable that if all dealings in electric lighting matters had been just and right we should not have to deplore the want of enterprise which seems now to have taken such a fast hold in this country? If worthy Mr. Hall is not more successful than some of his better known competitors in the electric lighting handicap, it seems to us that he will have to travel far away in the "ewigkeit" before he can hope for a cessation of his labours and be able to retire upon a modest competency. Only last week we had occasion to refer to the wonderful creations of the late Charles Dickens being completely outclassed by those who are living to-day, and here we find an old curiosity shop of a kind which even in its highest flights the imagination of our greatest novelist would have failed to conjure up.

WATT'S process for the electrolytic treatment of zinc appears likely to attract much attention at no distant date. Reports furnished by Prof. Silvanus Thompson, Mr. W. C. Mountain, and Mr. Guy C. Fricker all agree in describing the invention as a thoroughly practical one, and capable of being carried out on a large scale without difficulty and with economical results. The electrolytic recovery of zinc from its ores possesses advantages over all furnace methods, and it is stated that by this new process it may be successfully obtained from ores which have hitherto been thought unsuitable for the dry process. The treatment can be applied to all the ordinary ores of zinc used in commerce, and lead, copper, silver, and gold residues may be economically recovered as bye-products by ordinary metallurgical processes. The current in excess of that demanded by theory to produce a given deposit has been found by the three gentlemen whose reports we have perused to be from 5 to 10 per cent., which must be considered as very nearly approaching perfection, the deposit being exceedingly smooth and reguline, and free from crystalline irregularities. It appears to be beyond a question of doubt that Watt's process is a good one, whether viewed from a scientific or commercial standpoint, and likely to turn out a commercial success. We believe that a company is in process of formation for developing and working Mr. Watt's patents, and it is estimated that the total value of the savings which the electrolytic process allows over the smelting method will fairly amount to 30 per cent. We can see no reason why a company with a fair capital, and without being handicapped with absurd and exorbitant prices for patent rights, should not do a really sound and profitable business in the electrolytic recovery of zinc by the Watt system, the well known experience of the inventor being a guarantee that the principle upon which he works is the right one.

"It is reported" that Mr. Thomas A. Edison is experimenting on a new electric flying machine, for which he has been commissioned by the Spanish Government. H'm!

RAILWAY ACCIDENTS.

THE Board of Trade returns of railway accidents and casualties, as reported by the several railway companies in the United Kingdom, during the three months ending March 31st, have now been issued, and in more than one instance afford instructive reading.

Altogether the total number of persons killed and injured amounts to 209 killed, as against 229 for the same period 1887, and 934 injured as against 843—showing a decrease of 20 in those killed, and an increase of 91 on those injured. These figures include casualties from all causes, including trespassers (or suicides), but exclusive of those arising upon railways in which the movement of trains was not concerned. The number of passengers killed by accidents to trains, rolling stock, permanent way, &c., is 1, and of injured 162, an increase of 1 killed, and 27 injured. Accidents to passengers from other causes result in 22 killed and 182 injured, an increase of 14 injured, and a decrease of 2 killed. To servants of the companies or contractors the results are 88 killed and 551 injured, as against 128 killed and 489 injured for the corresponding period 1887, a decrease of 40 killed, and an increase of 62 injured.

Of the several cases enquired into some half-dozen call for comment on our part.

The first is that of the collision which occurred on the Dublin, Wicklow and Wexford Railway on the 21st of February, in which eight passengers and the driver of the passenger train were injured. The line is worked by the train staff and ticket, but without the block telegraph system. The collision occurred between a passenger train from Dublin for Wexford, due to leave Enniscorthy at 5.3 p.m., and a portion of a special cattle train due to leave two minutes later. There would appear to have been several contributory causes to the production of this accident. The company had sent down an officer specially to deal with the loading and dispatch of the special cattle trains on the day in question—Enniscorthy fair day. Misunderstandings would, however, appear to have arisen, resulting in a portion of the cattle train being allowed to proceed within five minutes of the time appointed for the arrival of the passenger train, along that line towards the north end of the station, upon which the train nearly due was to arrive from an opposite direction, and which almost immediately came into collision with it—the only protection for the operation being the down distant-signal.

Major-General Hutchinson, after dealing with the several points brought out in the evidence on this case, remarks: "If the signals at Enniscorthy had been arranged on modern principles, with the points and signals interlocked, with the block system in force, and the working in the hands of a responsible signalman, this collision would probably have been prevented; and it is much to be desired that the directors of the Dublin, Wicklow and Wexford Railway could see their way to introducing these improvements, not only at Enniscorthy, but at other stations on their system as yet unprovided with them." We heartily endorse General Hutchinson's remarks. There can be little doubt had the line been provided with electrical block signals that the collision would have been avoided, for in that case the approach of the passenger train would have been announced to the signalman some minutes before the arrival of the train, in which case it may be fairly assumed that the shunting of the cattle train would not have been permitted. No doubt the case indicates some careless working on the part of those in charge of the operations—such as the shunting at the time when the passenger train was due; but it is possible, although no such assumption ought to have been accepted, that the arrival of the train was not looked for in so punctual a manner. Were this so, however, had telegraphic communication existed no such doubt could have existed. The interlocking of the signals and points is, no doubt, equally desirable; but under the circumstances, we should be inclined to give the preference to the block. It is however to be hoped that the company will see its way to carry out the Board of Trade's suggestion in its entirety.

Following the report on the above accident is one from the same inspecting officer on a collision which occurred on the Great Eastern Railway, near Coburn Station, on this company's London and Ipswich line, during the prevalence of the foggy weather, which at the time appeared so constant. The collision was of a very minor character. Into its details we do not propose to enter, and we refer to it solely in order that we may have the pleasure of extracting from it a remark which, to our mind, is as honourable to the General as it is complimentary to the railway companies. Major-General Hutchinson thus concludes: "Considering the dangerous and difficult circumstances under which the traffic must have been carried on in the neighbourhood of London during the recent protracted fog, I think it only right to record my opinion that great credit is due to the servants of all the companies concerned for the care they must have exercised in conducting the traffic, and owing to which care the slight collision, which forms the subject of this report, is, so far as I am aware, the only one which occurred."

The next report which we have to notice is that dealing with a collision which occurred on the 25th of January, near Dunmow Station, on the Braintree and Bishops Stortford (single line) branch of the Great Eastern Railway. Two horse boxes were being shunted in readiness to be attached to an approaching train, over a falling gradient varying from 1 in 642 to 1 in 80. The porter in charge lost control of them, and they ran away towards Braintree, having nearly come to rest on a level portion of the line when they were run into.

The conclusion arrived at is that the collision was "principally due to an improper mode of working the block system between Dunmow and Felstead stations." It would appear to be the practice when any shunting is in hand at a station to signal trains forward from the adjoining signal cabin under a signal "section clear, but station blocked," and this was done in the present instance. On a level line such a signal is possibly admissible; but where a gradient exists, we concur with the report in the desirability of abandoning such a signal for trains approaching in the direction in which the gradient falls. The shunting should be done before the train is admitted into the section. Usually horse boxes are loaded some ten minutes or more before the train arrives, and if this cannot be effected in sufficient time to admit of the vehicle being shunted preparatory to its attachment to the train, it would be to the interest of all that the vehicle should not be allowed to foul the main road at all until the train signalled had passed out of the station. Possibly, in the present instance, no great difficulty would present itself in removing the gradient from the neighbourhood of the station: the 1 in 80 section appears but a very short piece.

The next case calling for remark is also one in which a gradient fills a prominent part. On the 2nd of January a collision occurred between a Midland passenger train and a Great Northern goods train near the King's Cross junction of the Metropolitan Railway. The collision was of a very minor character, and was entirely the result of the driver of the Midland train over-running the up home signal at the junction cabin. The Midland train was proceeding towards the City, whilst the Great Northern train was proceeding from the City; thus the latter had to cross the route of the former at the junction named. Happily the Great Northern train had completed its passage across the route of the other train, with the exception of the end portion of the tail van, ere the engine of the Midland train came into contact with it. Major Marindin points out the serious consequences which might have ensued had the Great Northern train been a second later, or the Midland been less under control.

The section of line has only recently been provided with additional protection by the addition to the ordinary Spagnoletti block of Mr. Spagnoletti's electrical interlocking system; and at the suggestion of the Board of Trade a new block post for the purpose of exercising a more complete control over up-trains traversing the falling gradient which connects the Midland with the Metropolitan system has been established. Major Marindin now recommends the introduction of still another signal post, and the keeping back at such post all up Midland Metropolitan trains so long as a down Great Northern train remains in the adjoining section. We think Major Marindin's recommendation a sound one, although it appears somewhat hard on the Midland that they should be called upon, so shortly after having complied with the demands of the Board of Trade for what was then, we presume, considered a complete provision for the protection of this junction, to incur a further charge of this character.

The next report deals with a case of more than usual interest, regarded from an electrical point. It is that in reference to the collision which occurred on the Metropolitan Railway on the 19th of March. In this case, as the 7.11 p.m. down Metropolitan passenger train from New Cross to Hammersmith was standing at the home-signal at Devonshire Street box, it was run into from behind by the 7.33 p.m. down Great Western train from Aldgate for Kensington. The collision was a slight one, no vehicles leaving the rails. Sixteen passengers complained of injury at the time, the number being eventually increased to 49; but in no case, it is stated, were the injuries of a serious character.

Devonshire Street signal box is a block signal post between Portland Road and Baker Street stations. Absolute block-working is in force, supplemented by Spagnoletti's lock and block arrangement, under which the starting signal lever at each block-box is electrically controlled by the signalman at the box in advance, so that where all is in proper order the signal cannot be lowered until the signalman in advance gives "line clear," and takes off the lock on the signal lever, and this he is prevented from doing until the previous train has passed over a treadle in advance of his own home signal.

The accident was the result of the Devonshire Street down distant signal being off when it should have been at danger, the preceding train not having passed out of the section. It is admitted that the failure was due to the electrical apparatus, and Mr. Spagnoletti traces this to a defect in the "earth" connection at the Devonshire Street box. The earth connection was by means of a gas pipe; rust had set in, and partly or wholly severed the connection with the wire. The failure was not due to the passage of the current from one section to the other, but from a return charge of the wire or coils of the instrument. The lock at Devonshire Street box and that at Portland Road is upon the same wire: that is, the lock at the latter for up-trains and the lock at the former for down trains. "In this particular case, it appears that when the man at Portland Road sent the current to take off the lock at the Devonshire box, he charged the wire and the coils at the other end with electricity, which through a defective connection with the earth . . . . did not allow the current to pass freely to the earth . . . . and the electrical charge in the coils and wires returned through his lock (taking it off) to the earth at Portland Road." With a high battery power and delicately-adjusted instruments we can quite realise such a result, especially with gutta-percha covered line wires. We think Mr. Spagnoletti would do well to increase the distance between the make and break of the signalling key, and possibly he might insert an earth spring between the two positions, so as to intercept any return current.

In concluding his report Major Marindin observes:—

"What, in my opinion, makes this failure the more serious, is the fact that the defect in the earth connection at Devonshire Street was not discovered at once . . . . so that, in spite of careful periodical examination by the telegraph linemen, it is quite possible that some similar fault in an earth connection may remain undetected until it has led to a serious accident.

"This is a question which should receive the most careful attention from the electricians upon all the lines of railway upon which this, and similar inventions, are in use, for the very essence of such appliances, which in a measure tend to relieve signalmen from personal responsibility, should be their absolute reliability, and there can be no doubt but that the proper arrangement would be that any failure whatever in the instrument, involving danger, should throw it out of gear, so that it cannot be used at all until all is put right for safe working.

"It is quite apparent that the provision of a separate wire for each line, instead of one wire common to both as at present, would prevent such a failure as the one under consideration; and if a complete and certain remedy cannot be devised without such an addition, I trust that the company, considering the grave results which might ensue in any similar case, will not shirk the expense of making it."

We have no doubt Major Marindin's remarks will receive very careful consideration at the hands of railway electrical engineers. We cannot, however, refrain from remarking, that it would also be well to so draft the regulations for working the traffic that it should not be possible for a mishap of this kind to lead to such consequences. Of course, it is a most undesirable thing that a signal electrically locked in the manner indicated should be unlocked otherwise than by the signalman at the proper time; but railway working should be rendered more secure than by mere dependence upon an electrical current; for purely that is what it means in this case. A current passes along the wire, no matter where it comes from, and the lock is released. Block signals were in use. These should have been the governing signals more than the electrical lock indicator on the starting signal. By the electrical block the signalman should work. Practically he should not know that his mechanical signal is locked. When his electrical signals give him the clear signal he should be at liberty to take off his mechanical signal. The lock on the latter should be a check to prevent the man taking off the signal when the line is not clear. We are not at all satisfied that this method of signalling was in operation on the section of line affected; but as the block was there as well as the interlocking, we can only regard it as desirable it should be.

As we understand the interlocking system in use, it is a momentary current system, and as such, we opine, is open to the action of any current which may get upon the wire. Safeguarded in a proper manner, there may be no objection to this; but there can be no question that it is far less reliable than a constant current system. Major Marindin suggests the employment of one wire for the up line lock, and one for the down line. This, no doubt, would relieve the apparatus from a failure such as that which is said to have caused the occurrence in question; but it would still leave the apparatus open to the action of a foreign current, the result of contact between the line wire and some other wire. The retention of the lock-off by constant current is apparently the only safeguard—any failure of the said current to cause the lock to go *on*—a course which we understand Major Marindin to recommend; but a course which will not be secured by merely adding another wire to the system.

Major Marindin's observations quoted above would seem to carry a general stricture upon all interlocking systems. We do not think this is intended. Interlocking systems, properly designed, are built upon the principles recommended: that is, they maintain the *lock free* by the action of a constant current; and the lock is only allowed to go on when this current ceases, whether by the act of the signalman, or by the failure of battery, line wire, or other cause. Still even with this there is the possibility of failure. The wire may become in contact with a repeater wire, borrow a portion of its current, and it may be that this current may be strong enough to release the lock. All this only shows the necessity of working these adjuncts under such instructions as will not admit of their being dealt with independent of the electric block signals. With properly devised instructions, properly carried out, there should be no fear of accidents.

The returns include one more report, in which reference is made to the electrical apparatus. It is that referring to the accident on the South Eastern Railway, which occurred at the North Kent East junction, near New Cross, on the 15th of March, and upon which we have already commented.

ON ELECTROLYSIS BY THE ALTERNATING CURRENTS OF DYNAMO MACHINES.*

By MM. G. MANEUVRIER and J. CHAPPUIS.

If the alternating currents of a dynamo are passed into an ordinary voltameter containing water acidulated with pure sulphuric acid, and having plates or thick wires of platinum, no liberation of gas is generally observed at the electrodes. It seems as if there was no decomposition of the acidulated water, though the circulation of the currents is perfectly established. For instance, with currents of 250—300 volts and of 4—5 ampères, which would easily supply a system of lighting, whether by arc or glow-lamps, we do not even perceive traces of gases at the electrodes, provided that their dimensions exceed 0·1 centimetre in diameter and 4 or 5 centimetres in length.

This is the explanation of the common opinion that the alternating currents of dynamos are no more capable of decomposing the acidulated water of a voltameter than of deflecting the needle of a galvanometer. But this opinion is erroneous. The incapacity of electrolysis is only apparent, for if in one and the same voltameter we substitute very fine wires for the broad electrodes, the same alternating currents produce immediately an abundant escape of gas.

The experimental study of this phenomenon leads to the following conclusions:

1. For currents of a given intensity their exists a platinum electrode of such a surface that the gases are not liberated, and that the electrolysis is, or seems to be, completely arrested. If we then gradually diminish the surface of such an electrode by reducing either its length or its diameter, the escape of gases appears, and is so much the more abundant as the electrodes have been reduced in a greater extent.

2. Inversely, for platinum electrodes of given dimensions their exists an intensity of current below which there is no development of gas; the decomposition is produced, on the contrary, at an intensity above this limit, and it increases with such intensity.

3. In all cases chemical analysis proves that the gases collected at each electrode have the same composition. They are the gases of water, forming a detonating mixture, but with a proportion of oxygen below the third of the total volume. Moreover the volume of this detonating gas per ampère and per minute is always more or less inferior to the theoretical quantity, 10·4 cc., which would be given off under the same conditions by a continuous current.

One of the most interesting circumstances connected with this electrolysis is that ozone is produced at each electrode, in spite of the presence of hydrogen. If we allow the gases to escape freely into the air, this ozone is manifest to the sense of smell by its strong odour, and the characteristic white fumes are visible. We have determined their proportions, which are variable at one and the same temperature according to the density of the current—the chief factor of the phenomenon—and according to the nature of the electrodes and of the electrolyte. But we wish at present to speak only of the fact of its production, which plays an important part in the interpretation of the phenomena above mentioned.

It seems natural that if we have at one and the same electrode the simultaneous production of strongly ozonised oxygen and of nascent hydrogen, the slightest external influence will suffice to effect the reconstitution of water at this electrode, and in consequence the disappearance or the reabsorption of the gases. In the case of platinum electrodes this determining external cause is precisely the condensing power of the metal, which is exerted in proportion to the metallic surface in contact with the gases, whence results an admissible explanation of the three foregoing phenomena.

This view is confirmed by several of our experiments, of which we cite two.

1. Copper electrodes do not decompose acidulated water under the same conditions of density of current in which it is still decomposed by platinum electrodes. They become covered, however, with a layer of red reduced copper, and if we then substitute for them much finer copper wires, there is produced an abundant escape of gas. But it does not last long, since these electrodes become, so to speak, dissolved in the liquid in the form of threads of pulverulent red reduced copper.

The copper, therefore, is first oxidised by the ozonised oxygen, and reduced again by the hydrogen with recomposition of the water. It is plain that if the surface available for this reaction is sufficient, there cannot escape the least bubble of gas. Here, therefore, we have reabsorption of the gases of the water, and the external determining cause is a double chemical reaction.

2. With electrodes of mercury of a large surface gas is evolved in small quantities, and there is produced at the same time a cloud of white matter which gradually pervades the voltameter. This gas consists almost entirely of hydrogen, whilst the solid matter is mercurous sulphate, a very sparingly soluble salt. But under the same conditions the transit of a continuous current produces exclusively mercuric sulphate. Here again, therefore, we have a re-constitution of the water at the expense of the gases which would have been evolved, and the cause determining their re-combination lies at once in the absorbing power of mercury for gases, and in the double reaction undergone by the metal and the mercuric sulphate.

These secondary reactions explain at the same time the discrepancy mentioned above as occurring between the volumes of gases collected at any given intensity of the alternating currents and the theoretical volumes deduced from the law of Faraday. Still we shall show that by means of a suitable choice of the electrolyte and of the electrodes we may effect, directly or indirectly, reactions whose products are strictly proportional to the total quantity of electricity which has passed through the electrolyte. We shall thus have a voltametric method for measuring $\partial\ i\ d\ t$ (disregarding the sign), and the electrolytric apparatus thus produced will form a totaliser or counter of electricity for alternating currents.

These two experiments prove how far the reactions, direct or secondary, of electrolysis by alternating currents differ from the reactions of ordinary electrolysis by continuous; we have observed many other instances which we shall make known at an early date.

It must be added that the escape of detonating gas renders these electrolytic researches delicate and even dangerous. There is perpetual risk of spontaneous detonations unless we take, in collecting the gases, certain precautions which will be indicated in an early communication.

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* *Comptes Rendus.*

Electric Railway.—A somewhat new departure has been made on the Ansonia, Birmingham, and Derby electric street railroad, to which reference was made in the REVIEW for June 8th last. The line is worked from an overhead wire 380 mils. diameter suspended from cross wires stretched between poles on either side of the track. The return is along the rails, which are of the ordinary pattern, special copper fish plates being used. Connection between the cars and the wire is made through a grooved wheel pressing upwards against the wire. The cars carry motors of 15 H.P., and in the generating stations at the Derby dock a 100 H.P. engine and boiler and an 80 H.P. dynamo have been erected.

PRACTICAL NOTES CONCERNING THE CONSTRUCTION, USE AND MANAGEMENT OF STORAGE BATTERIES.

By A. RECKENZAUN.

(Continued from page 666, *Vol. XXII.)*

Experiments with Storage Battery Cars.

DURING the month of December, 1887, a series of tests were instituted with electric tramcars driven by accumulators and electric motors. Some of the tests were made with car No. 3 in the large yard of the Electric Car Company of America, in Philadelphia, and others with a second car sometimes on this experimental line and sometimes in the streets of the city named. These cars varied in dimensions, and they were differently constructed, therefore we attach numbers to each in order to distinguish them hereafter. The yard in which the rails were laid is an irregularly shaped four-sided space, and there are four curves, two of which have a radius of 50 feet, one 33 feet, and one 100 feet, measured to the centre of the track. The rails formed a complete circuit of 1,005 feet in length, and this we call one round trip. The rails tangential to the 33 feet curve were laid upon an ascending incline of 1 in 20, sloping down again beyond the summit of the hill at the rate of 6 feet in 100, and this slope finished with the 100 feet radius curve.

Car No. 3 contained 116 cells, all of which were used during this experiment in supplying current to two of the author's electro-motors, which were fixed to a pair of bogies. The entire weight propelled was 7·4 tons; the battery alone weighed 2·14 tons, the rest being made up by the car itself, the motors and gearing, and the passengers on board.

Three men, each well trained for his work, were required for these tests, and their duties were as follows:—One man took charge of the switch in front of the car and the brake; in fact, he did the ordinary duties of a driver, taking care that the car ran at regulation speed on the level, that it did not "race down grades" nor go too slow up the inclines, and that it took the sharpest curves with safety. The second man with a timepiece in his hand counted the number of round trips and recorded it carefully, he also watched the voltmeter periodically. The third attendant had the most difficult task of taking readings on the ammeter, and writing them down as fast as his skilled hand and pencil would allow it. It will be noticed that on a line of this description with constantly recurring curves and no straight piece of track of more than 200 feet in length, the energy consumed must vary continually. A sensitive ammeter, as near dead-beat as it can be made, was used, and the attendant could take and write down 41 readings during a round trip lasting on an average 1·45 minutes. This gave one reading to every two seconds about, and in order to do this with approximate accuracy some practice was required. Very few stoppages were made because it was the intention to ascertain the number of miles this car could make with one charge of accumulators on this awkward track, without allowing the E.M.F. to drop below a certain minimum, and this minimum was fixed at 10 per cent. drop. The E.M.F. was taken every half hour: at the commencement the entire battery gave 227·36 volts when the car ran on a comparatively level part of the track, and this corresponds to 1·975 volts per cell. At the end of the experiment the battery gave 205·42 volts under similar conditions, consequently there was a loss of nearly 22 volts between the first and the last readings. When near the summit of the hill the greatest amount of current, averaging 80 ampères, was used, and at that instant the E.M.F. dropped by about 14 volts below that used on the level, but it recovered immediately when the circuit was entirely broken on the down grade, or when reduced to its normal value on the level road.

The temperature of the air varied between 30° and 36° F., the rails were dry and tolerably clean, and we made 331 round trips, each of 1,005 feet, in exactly eight hours. This represented a total distance of 63 miles, or an average of nearly eight miles an hour. From the plan of the line we computed that the car had to traverse 5·438 miles of curved track of 33 feet radius; 10·4 miles of 50 feet radius, and 4·918 miles of 100 feet radius. The aggregate of ascending grades came to 5·656 miles, and the down grades to 5·128 miles, whilst the entire distance of straight and level track gave 22·46 miles.

About 13,000 observations were recorded on paper, these were averaged and gave a mean current rate of 18·5 ampères; down the grade and for a good distance beyond, the car was run by gravity; on leaving the 33 feet curve and entering the up grade the current gradually rose from 40 to 80 ampères, and on the level it varied between 10 and 15 ampères. By "level," we mean *comparatively* level, because the ground had undulations which represented slight gradients, but these were averaged up so as to give the value of a straight track.

The energy was thus consumed at an average rate of 216 × 18·5 = 3,996 watts; this gives 5·35 H.P., and for the entire 63 miles, 42·8 H.P. hours.

The maximum energy supplied at any moment by the battery was 213 × 80 = 17,040 watts = 22·84 H.P. Each car mile costs in this case ·663 of a H.P. hour, which can easily be expressed in money value when we know the price of a H.P. hour in the prime mover. From the above it will be seen that the useful storage capacity of the accumulators was 148 ampère hours. Before the experiment commenced, the specific gravity of the acid in each cell was ascertained, and the average calculated, this gave 1,186 degrees. Immediately after the 63 mile, or 8 hours' run, the acid was again tested and gave an average of 1,130 degrees for the whole set; consequently, there was a fall of 56 degrees, which would give 1·3 degrees per horse-power hour, or nearly ·89 degrees per car mile run.

The work done may also be expressed in ton miles, 7·4 × 63 = 466·2 ton miles, which caused an expenditure of 42·8 horse-power hours, or 10·88 ton miles per H.P. hour.

After the above experiment the accumulators were recharged until the acid density rose to 1,190, and gas bubbles came off freely. The average energy consumed during the charge was 6,181 watts for 7·5 consecutive hours, giving a total of 62·14 electrical H.P. hours. The cells were not new, but they have served the purposes of electric traction for six months preceding the present record.

(To be continued.)

ELECTRIC LOCOMOTION.

By C. P. ELIESON.

HAVING had considerable experience in electric traction, which in our days is trying from all parts of the world to force itself into some practical and useful application, I venture to ask permission to insert a few remarks in your valuable Journal, with the hope that some of my co-workers may find them useful and agree with me that there are many points of difficulty yet to be overcome. It is perfectly clear to everyone that electric traction is a *fait accompli* as far as the nature of the thing is concerned; no one will doubt for a moment that electricity will ultimately supersede horseflesh; this, of course, is only a question of time, not I sincerely hope very far distant. But the object of writing these lines is not to acquaint the reader with facts he already knows. My desire is only to impress upon those interested in electric locomotion the importance of the mistakes which we have all experienced and which instead of being avoided are still continued with the sanguine enthusiasm of ignorance, scarcely credible in the present days of advancement in science and mechanical knowledge. Let us consider the first attempt at electric locomotion with accumulators in this country, which took place about six years ago and proved an utter failure. Experiments with this car were first made on one of the lines of the North Metropolitan Tramway Company, but after several attempts to run it, it was abandoned in a field. Some months afterwards the police tried to find the owner of the property, and as nobody came forward to claim it, the residents in the neighbourhood thought they had a right to it and everyone who could carried off a part of the spoil. Now, on what principle was this car constructed? It was one of the ordinary size in use arranged to receive the motor underneath and the accumulators beneath the seats; the motor was coupled with a leather belting transmission to a pulley of one of the axles of the car. In order to reverse the motion of the car a double pair of brushes was adjusted to the commutator. The leather belting transmission soon proved a failure and a chain coupling was substituted, but with no better success. I do not know if there were other difficulties in connection with the system, but ultimately the whole construction was abandoned, as above mentioned, and this was the miserable end of the first attempt at electric traction in this country.

Now let us see what advance has been made since that time?—what were the first mistakes which led to failure? and what has been done to avoid them? It will at once strike the reader that some advance has been made but very few mistakes rectified. It is deplorable to chronicle that every car on *soi-disant* different systems have been built on lines almost identical with the first, with more or less little improvements, but not decisive enough in their character to secure reliable running.

I will now try with the help of all others who feel an interest in the matter, to see if there is not any possibility of finding where the difficulty lies. I certainly think that responsibility rests with the electrical community at large for having started wrong principles and constantly encouraged engineers to construct motors not fit to fulfil their intended work. In all electrical centres there is still a fatal tendency to make dynamos and motors to give a maximum electrical efficiency combined with an absolute minimum of weight. These deplorable lines have led to as many failures as there have been attempts in that direction. Of course, a very light motor can be constructed, and the tests made upon it will, no doubt, deserve great praise for their efficiency; but, unfortunately, the practical application of such a thing ceases with the laboratory tests of the same. A dynamo of such marvellous achievements is only fit to be put under a glass case, not to perform actual work for any length of time. When a steam engine is constructed, no false economy of metal is made in any of its parts, but it is built so that uniform working may be secured and vibration avoided to the utmost. If these points be neglected, what can you expect? No sooner is it put to do its work than wear and tear set in, and then begins the bitter experience of breakdowns; but our brethren of steam know too well how to construct an engine. But, on the other hand, electrical engineers have almost come to the very unpractical way of weighing the parts of a dynamo in a gold scale.

Taking, for instance, the work performed by one of the motors of about 4 H.P. on the electric locomotives at Stratford; when coupled to a full-sized car loaded with 48 passengers, the E.M.F. being 160 volts, it takes 25 ampères at the rate of between 8 and 9 miles an hour, but on some occasions, when the road is dry and the grooves are clogged (by no means a rare occurrence, and, I may state, almost continual in dry weather, as watering the line is considered a luxury), the engine and loaded car in starting will take as much as 75 ampères for a short time, which would mean about 16 E.H.P. If the motor and all other parts have not been constructed to sustain such a strain, which is repeated every few minutes, it will be easily seen that breakdowns will succeed on a rapid scale, to the disgust of everyone. Do these failures teach others better? No; there seems an almost fatal inclination to attribute the failure to anything but the real cause, and for years different systems have started on the same principles, and everyone has gone through exactly the same mishaps.

I will abstain as much as I can from speaking of my own system, as I do not seek for praise nor publicity, but my experience of electric locomotion has given me knowledge of facts which I have gained while engaged in overcoming difficulties. Therefore, in the interests of electric traction, I strongly urge all who are trying to bring their work to a practical issue to avoid these mistakes and the advice of some amateurs and so-called connoisseurs of electrical engineering; what they in their limited knowledge may consider a clumsy combination or construction is the very soul of the intended purpose which has been aimed at, and must be secured on and above all anticipation; if the mechanism be heavy, power must be provided in proportion and above. If the weight of the machinery (of whatever nature it may be) be reduced in order to economise the motive power, the object for which it was intended is destroyed. The persons interested in the work at the first hitch will, to a man, condemn it at once.

Many good things have been lost to the hard-working seeker, not on account of his invention being useless, but simply on mechanical grounds, or on the relation between strength and actual power to be applied having been badly designed. I do not intend here to pass an opinion on the systems used and applied between the motor and axle of a car, I believe this can be arrived at in many different ways. Too many failures have been experienced in the past, and will still be met with in the future, unless a sensible motor be once and for ever secured. In neglecting this, economy may be made in one direction, but on the other hand the evil of failure is created exactly in the same proportion. These remarks I feel sure apply to all dynamos where efficiency, combined with lightness, lead to weakness, quick wear and tear, and frequent breakdowns.

In accumulators the same evil principles have been followed, and an accumulator of large storage capacity and minimum of weight is still the idea of the day. It is astonishing, considering the world-wide, and I may say indispensable, application of accumulators, that electricians have not yet found out what should constitute a good and reliable accumulator. In my experience of the same I should advise, before all, strength, or in other words duration of life. After securing this, I would combine it with the best means to obtain the highest storage capacity, but under no consideration is the storage capacity to be increased at the expense of its durability. Accumulators with numerous thin plates have proved to be practically useless. Their storage capacity may have appeared astonishing as compared with their weight, but their life was of a duration of weeks only. Thicker plates are now employed and better results obtained, but there is still that illogical tendency to economise weight, which still keeps the accumulators in an unsatisfactory stage. The ignorant public, who know nothing of what constitutes the working of a storage battery, will ask for impossibilities, and the maker, in order to secure business, tries to distort the facts of science and to deceive himself in order to satisfy the demand. The result is that an article is supplied which is unfit to fulfil its work. But if manufacturers of secondary batteries would arrive at sound conclusions and identify themselves with the strict rules their large experience has already taught them, viz., that a pound of lead should be worked to a certain storage capacity, up to which point it would be safe, then strain and extra oxidation, which greatly adds to the expansion and contortion of the positive plates, would be avoided. If charging were stopped at that point, I am certain it would insure a long life to the accumulator. This, of course, would diminish storage capacity as against weight, but it would certainly be the proper thing to do, instead of trying to accommodate sheer impossibilities.

Under these rules makers would be enabled to work in broad daylight instead of groping in the dark, and seller and buyer would mutually benefit in the operation. A boiler maker for steam engines will make a boiler to be worked with safety at so many pounds pressure on the square inch and no more, so should manufacturers of accumulators know the safe working limit of storage capacity per lb. of lead. I am therefore of the opinion that dynamo and battery makers have only themselves to blame for so many hardships and unsatisfactory work which has so greatly injured the rapid progress of electrical matters at large. Let us not deceive ourselves, and we shall not deceive others.

INCANDESCENT LAMP PATENTS.

Edison and Swan United Electric Light Company *v.* Holland and others.

(*Before* Mr. Justice Kay.)

(*Continued from page* 601, *Vol. XXII.*)

This case came again before Mr. Justice Kay on Monday, upon the conclusion of the joint experiments under the supervision of Prof. Stokes, who made a report to the Court which will be found below. Mr. **Finlay** addressed his lordship on behalf of the defendants, acting upon the suggestion of the judge to make his remarks as brief as possible, the case having already occupied the Court twenty-one days. He said the present case stood on a very different basis from the Woodhouse and Rawson case, for whereas in that case great importance was attached to the assertion of the plaintiffs that Edison's patent signalled the commencement of an enormous trade in incandescent lamps, it was now undisputed that no practical Edison lamp was seen until long after the date of the patent It is unnecessary to go in detail into the arguments of the learned counsel, for the reason that our readers are for the most part acquainted with the principal points. Mr. Finlay emphasised the evidence of Mr. Swan to the effect that when he first saw Edison's specification he was not particularly impressed by it, and did not regard it as "solving the problem." Towards the close of his address he spoke of the fact that Mr. Edison was neither called nor his evidence taken as being extraordinary, and suggested with regard to the lengthened manipulation of the tar putty before a filament became possible, as exemplified in the experiments before Prof. Stokes, that the plaintiffs might have been in communication with Mr. Edison and learnt from him this and other important details in manufacture; they must have been aware that the protracted manipulation, of which the defendants' witnesses never dreamt when their independent experiments were made, and of which no "ordinary workman" would ever dream, was an essential part of the process, and they ought to have stated the fact whilst in the witness box. There was nothing either in Edison's specification to lead anyone to suppose that such long-continued operation upon the tar putty was essential, and that was sufficient to vitiate it. The evidence relating to both patents was rapidly reviewed, counsel remarking that Prof. Stokes's report had rendered it unnecessary to dwell upon many points which would otherwise have called for fuller treatment, and the address was concluded in the early part of the afternoon.

The **Attorney-General**, who was engaged in an important case (the *Times* libel case) in another Court, was only able to devote about a quarter of an hour to his closing address for the plaintiffs. He briefly stated the main contentions of his clients and their answers to the contentions of the defendants, and then left Mr. Moulton to put the cases relied upon to his lordship. He said, with regard to the main attack of his learned friend on Edison's specification, that it was only a reduction of the size of the cross-section of the carbon conductor, that that point was absolutely disposed of by the Court of Appeal. Exactly the same point was taken in the last case, and he (the Attorney-General) opened that case by stating that a vessel of glass, leading platinum wires, and carbon conductors, were all old, that they were all put together in Swan's lamp exhibited at Newcastle in December, 1878, and that, so far from having led to the discovery, no single practical step was taken until after Edison had published his invention. It was said that Mr. Swan had worked it all out for himself; but it was most remarkable that after the lamp of 1878, during the whole of the year 1879, Mr. Swan was going in the wrong direction, which he himself admitted.

Mr. **Moulton** occupied the remainder of the afternoon, upon the termination of the Attorney-General's brief speech, in submitting the cases to his lordship, and was at one point interrupted by the **Judge**, who said the Court was not being fairly treated. The address had been broken up, and he had practically to listen to two addresses. He desired counsel to make his remarks brief, or he should be compelled, in justice to other suitors, not to hear him. Most of the cases cited were those introduced in the Woodhouse and Rawson trial, and it is needless to repeat them here. Upon the conclusion of Mr. Moulton's remarks,

His **Lordship** reserved judgment.

Prof. **Stokes's** report was as follows :—

My Lord,—Having accepted the office of independent reporter on experiments made in conformity with the order of the High Court of Justice in this case, of date June 1st, 1888, I have the honour to report as follows :—

The places chosen by the two parties for conducting their respective experiments were, by the plaintiffs, the works of the Edison and Swan Company at Ponder's End; by the defendants, the laboratory of Mr. Crookes, at his house, 7, Kensington Park Gardens. The two experts on the side of the plaintiffs were Prof. Dewar and Dr. Hopkinson, and those on the side of the defendants were Mr. Crookes and Prof. Silvanus Thompson. It was agreed between the two parties that the counsel on both sides should also be present.

We met at Ponder's End on June 11th, 12th, 14th, and 15th, and at Mr. Crookes's house on June 18th, 19th, and 21st. The first process shown us at Ponder's End was the preparation of the so-called "tar putty," which formed the foundation of most of the filaments used in the lamps made in the repetition of the experiments. The ingredients of tar putty are coal tar and lamp-black, of each of which we saw a barrel just as purchased. The coal tar is used in the state in which it is procured; the lamp-black was calcined in a covered crucible placed in a brass furnace, and when taken out was preserved in stoppered bottles. I saw a good-sized earthenware crucible filled with raw lamp-black, its cover luted down, and the whole put aside for the luting to dry preparatory to ignition. It was not, however, deemed necessary that I should actually see the ignition, which is a very common laboratory process; and it was agreed on both sides that the black powder used should be taken as calcined lamp-black.

The putty was made by a strong-looking, youngish man named Plum. It was made on a table, on which a flat piece of hard-looking wood had been screwed down as a fixture. Some calcined lamp-black was first triturated a little in a mortar, and then poured on to muslin, which was tied into a bag. A suitable quantity of coal tar was poured on the board and dusted with charcoal, by shaking the bag over it. The two were then incorporated by using a rigid iron or steel tool, shaped much like a chisel, but not ground to a sharp edge. The charcoal was repeatedly added by small quantities at a time during the process, each fresh charge being incorporated before the next was added.

When the work had progressed some way, and the putty was beginning to get stiff, Plum evidently used considerable force. Holding the end of the tool in one hand, he strongly pressed the tool against the table, with the other hand applied towards the other end of the tool, nipping a small portion of the putty lump and then drawing it out into a thin layer by a horizontal motion. The lump was thus nipped bit by bit till the whole was spread out, when the putty was scraped up with the tool, rolled into a lump by the fingers, and the process repeated.

The quantities of tar and lamp-black and tar used were not weighed; the workman judged by experience when a suitable quantity had been added. The first piece we saw made took an hour and ten minutes in the making; it was somewhere about as big as a hazel nut. When rolled into a ball the putty may be squeezed between the thumb and forefinger without cracking at the edge, and hardly blackens the fingers.

Various batches of tar putty were made during our visit, and the operation does not generally take so long as above mentioned. It was suggested that the operation might be facilitated by passing the putty between two cylinders almost in contact, which were made to revolve with very unequal velocities. This suggestion was tried next day with a slight modification, an instrument being employed which had been used for a different purpose, and which contained two brass cylinders almost touching, movable round their axes, which were parallel, one cylinder being turned by a winch, the other left free. On trial the putty was forced through in a sheet, with powerful shearing, inasmuch as the free cylinder was jammed by the pressure until the lump had been forced through. The putty used in the actual experiments was, however, handmade as heretofore.

The first process shown us in applying the tar putty was that of rolling out. Fifteen grains of the putty were weighed out by Mr. Gimingham, and given to a boy to roll. A piece of plate glass, ground on the upper surface, which lay on the table, was covered with fresh white blotting paper, which was kept from slipping by turning the edges under the glass. The weighed ball, having been placed upon the paper, was rolled with a tool formed of a smaller piece of plate glass, ground dull underneath, and provided with a wooden handle. This was moved backwards and forwards till the ball was rolled out into a cylinder of the prescribed length of 6 inches. This was then divided into lengths of 1 inch, and these rolled in succession just as before to a length of 6 inches and divided into 1 inch lengths. These were rolled out to the length of 5 inches to make the final filaments, the rolling being done as before, with the exception that the under glass was used bare, and that a spatula might occasionally be used to effect a local thinning. The total length of filament, if undivided, would thus be 15 feet.

The filaments, prior to roasting, were bent into different shapes, sometimes that of a plain elongated horse shoe, sometimes that of a spiral.

The chamber used for the firing of the horse shoes was a rectangular box of cast iron, with a loose lid of the same material. The box was about 6 inches by 3 inches, and 1½ inches high.

It held six or seven horse shoes resting on the bottom, and was first shown us without packing, *i.e.*, with nothing but air over the filaments in the box. The lid was luted down and set on top of the furnace to dry and get moderately hot. It was then inserted, put into the furnace, a bit of silver wire put on the lid for a test, and the mouth of the furnace closed. After 26 minutes the furnace was opened, and the silver wire was found to have been melted, and the box was taken out and placed on an iron slab to cool. It was opened about 15 minutes later, and the filaments, while carbonised, were found not to have been burnt. They were taken out and handed to a girl to shorten slightly to a measured length and mount. By mounting is meant attaching the ends to platinum wires, so as to secure both mechanical and electrical connection. The wires had previously been sealed into one end of a glass tube which was left open at the other.

In mounting, the girl bent the ends of the wires to the proper distance apart, to fit the width of the base of the horseshoe. She then, with a hair pencil, put on the ends of the wires small quantities of a mixture of coal tar and lampblack, applied them to the ends of the horseshoe, and added, with the pencil, a little more of the mixture when the filament had been taken up. A minute jet of gas, blown by air, lay attached to the table, and the girl put the wire transversely into the jet, so that the heat conducted along the wire volatilised the hydro-carbons in the mixture without burning the filament. Minute additions of the mixture were made, if deemed required, to ensure contact, and were heated as before. The roasting was completed by a momentary introduction of the lump into the edge of the flame.

In a subsequent experiment, one being of a filament after mounting or partial mounting, was accidentally snapped just above the carbonised mixture. It was easily mended by application of a little of the mixture, which was carbonised a little beyond or at the edge of the flame.

Another process for carbonising the junction which was shown us consisted in holding the filament at the end of the glass tube over a small disc of cast iron, which was heated from beneath by a blast of gas and air. Naturally these carbonised filaments are tender, and require careful handling. Of the six filaments in the first box three survived, so as to be placed mounted in the hands of the glass blower for insertion into lamps.

The carbonising filaments in the furnace takes half-an-hour or so, and a contrivance was shown us for economising time by roasting three layers of horseshoe filaments in a box instead of one only. For this purpose cast iron plates or trays are provided, with short feet in the corners, and a short projection in the middle on the upper surface to lift by. There is room for two trays in a box, which thus holds 18 or 20 horseshoes. A box full of filaments thus arranged were carbonised before us.

Three other processes were shown us for carbonising the filaments in the rectangular iron box, or rather, another process in three varieties. In this process the box, instead of being left empty, was filled with a packing powder of some kind. A little was first strewed on the bottom, then a layer of filaments laid on, then more packing powder put in, then another layer of filaments, and then the box was filled with the powder, closed with the lid and luted. After drying and warming on top of the stove, it was put in and fired as usual, after due time taken out, placed on the iron slab to cool, and when cool enough, or at any subsequent time, opened.

In opening, the lid was first taken off, then a sheet of paper put over, and bent over the sides; then, the paper being held against the sides of the box, the whole was turned upside down on a table, the box lifted rather gently so as to avoid as far as might be a rush of powder, and then the heap cautiously searched for filaments.

When the box of filaments was left empty, the carbonised filaments were almost always found whole, and could be easily taken out; when packing was used there seemed to be more liability to breakage, whether it were in the slipping down of the powder into a slant-sided heap, or in the subsequent search. There was usually a certain amount of loss this way.

Experiments were shown us with three kinds of packing, viz., powdered wood charcoal, kaolin and silver sand. The process was just the same in the three cases, and in each case the filaments came out carbonised and not reduced to ash, of which I may here say once for all I saw no sign in the experiments made at Ponder's End.

The filaments, of whatever kind and shape, were usually connected mechanically and electrically with the platinum wires by the process already described; but we were shown also a different process as applied to horseshoe filaments. In this the ends of the filaments were connected with short platinum wires by means of little bits of tar putty rolled between the thumb and forefinger. The filaments were roasted as before in a rectangular iron box with charcoal packing. The carbonisation of the connecting bits of tar putty was thus effected simultaneously with, instead of subsequently to, that of the filaments. The platinum wires which went in bright came out dull, but the change appeared to be merely superficial, and the wires were not rendered brittle, but could be bent without breaking. The platinum ends were connected with the ends of the wires that had been sealed in glass by small brass clamps consisting of short hollow cylinders with a side screw.

Another form of filament of which numerous examples were shown us, was that of a spiral. To make spirals, the 5-inch filaments had first small bits of tar putty attached to their ends by rolling a little with the finger. These were destined merely to serve as weights for a temporary purpose. To form spirals, the weighted filaments were wound round bobbins, consisting usually of short sticks of pipeclay ware, with a strip of paper wound two or three times round the middle. Different kinds of paper were used to vary the experiment. The weighted filament having been placed astride the bobbin was coiled round it, generally with two turns, the weighted ends hanging down at the two sides of the cylinder, which was held approximately horizontal. There was room for two spirals on one bobbin.

The spirals were roasted in pots of cast iron shaped like galley pots, about 3 inches high by 2¼ inches wide. They were cast with upright projections inside, terminating in Y's, in which the ends of the bobbins rested. They had lids to fit, and the fitting was so good that luting was dispensed with, except in two or three cases near the end of the experiments, when old pots were used in which the iron had scaled.

The warming and roasting were done just as before. When the pots were opened it required careful handling to separate the carbonised filaments from the *débris* of the paper and take them off from the bobbins. Many came to grief in the process.

Another process shown us for the management of the spirals involved the use of a helix of thin copper wire. A suitable length of helix was taken, the spires pulled out slightly, so that they were the fiftieth of an inch or so apart, and the helix slipped over the paper-covered bobbin. The weighted filament was then rolled on so as to lie between the spires. After roasting, the carbonised spiral and copper helix were cautiously slipped off from the bobbin together, and the copper which had served as a support to the filament during this process was then dissolved off by nitric acid, and the carbonised filament was washed with water and dried.

A few filaments were tried without weights. They came out of the furnace mis-shapen and unsightly, but in other respects I am not aware that there was any particular difference.

Some sticks of chalk, tapering a little, prepared for writing purposes, happened to be lying on the table, and one on the defendant's side suggested that they might be tried without a paper covering, as affording an unyielding support. Some were cut accordingly to the proper length to rest on the Y's, and weighted filaments wound on on the bare chalk. After roasting in the furnace one came out broken, but the rest were slipped off the chalk with ease and safety.

Some tar putty filaments were rolled out a good deal finer than those above-mentioned, the same or a slightly less weight of tar putty being rolled into 36 portions of 12 instead of 5 inches length. The fine filaments, measured under a microscope, proved to be about 0·0066 inch in diameter; allowing for the difference of length, this makes the thicker first mentioned about 0·01 inch diameter. The fine filaments were cut to a suitable length, bent into horseshoes, and carbonised in the empty iron box as before, and the subsequent treatment calls for no special remark.

We were also shown the coating of tar putty filaments with other material. The first shown was asbestos powder, used as purchased. The glass plate being covered with white blotting paper, a small quantity of the powder was put on quite thin, and the filament being laid on the paper was rolled backwards and forwards through a small space only with the upper glass tool. The finished filament was somewhat lighter in colour, and on being viewed through a pocket lens was seen to be studded with particles of asbestos, between which the dark surface of the tar putty showed itself. The other substances used were silica (in the form of kieselguhr) and kaolin. As the treatment did not differ from that used in the case of asbestos, it was not thought necessary that I should actually see it.

Another material used for filaments was a mixture of tar putty with oxide of zinc; 80 grains of tar putty and 20 of oxide of zinc were weighed out and given to Plum to incorporate, which was done in a manner similar to the incorporation of the lampblack in the process of making the tar putty itself. The finished material appeared to be somewhat less plastic than the tar putty. Twenty-five grains were rolled out, as before, and made into 36 one-inch lengths, which were rolled again to five inches. A fine thread, rubbed with coal tar, was stretched beside the filament when it had attained, or nearly so, its proper length, and the two rolled together with the upper glass tool. This presumably was designed to render the subsequent winding safer; but filaments of tar putty with zinc oxide were also used without thread, and thread was sometimes incorporated in plain tar putty filaments, sometimes having been previously rubbed with coal tar and sometimes not.

Another mixture we saw used was tar putty and camphor. Eighty grains of tar putty were incorporated with 20 grains of camphor. The finished material seemed to be more plastic than the tar putty and was readily rolled out, except that the filaments seemed rather disposed to stick to the glass, which had to be cleaned occasionally with spirit or some hydro-carbon.

We were also shown the carbonisation of various fine vegetable fibres, Mexican fibre, bamboo, and others, which was done in the rectangular box packed in one experiment with charcoal, in another with sand, in another with kaolin. Some of the more springy fibres were kept in the horseshoe shape by elongated loops of thin copper wire, into which the ends were inserted. On opening the box after it had been fired in the furnace and had got sufficiently cool, the fibres in each case were found to be carbonised, and not reduced to ash.

The operations of the glass blower in inserting the mounted filaments into the globes destined to form lamps need not, I presume, be described. The globe at the opposite end opened out into a tube, a thinned portion of which was intended to be sealed to the Sprengel exhausting pump. Each lamp was sealed in an upright position to the top of a vertical tube belonging to the system of the Sprengel, and just below the place where the lamp was sealed was a circle of small jets of gas, the hot air from which warmed the lamps during exhaustion. Asbestos muffs were put round the lamps and circle of jets, to assist in the warming. When the operator was satisfied with the amount of exhaustion, the tube was melted near the bulb, and the lamp taken off as finished.

The lamps when measured were taken into the testing room to be measured for candle-power, current, and voltage. The condition in which they were measured was that in which the current was such as to give what was judged by the eye to be about the proper brightness to the filament. I saw 19 lamps thus treated, of which, however, two gave way. The lamps were then run for duration. During the three or four hours I was there, after the running commenced, one gave way after a life of 2 hours 25 minutes. I have received a list, dated June 21st, and signed by Dr. Hopkinson on part of the plaintiffs, and Mr. Sellon on part of the defendants, giving the results up to date. 17 lamps had died after an average life of 12·7 hours, and 12 were still running after an average run of 32·6 hours.

The experiments shown us at Mr. Crookes's laboratory related chiefly to (1) the preparation of the tar putty; (2) the carbonisation of vegetable fibres and tar putty filaments in crucibles; (3) the effect of calcination in charcoal packing on the platinum ends of filaments mounted before carbonisation; (4) the effect of passing a current through a filament coated with fire clay.

1. The coal tar used had been purchased at a neighbouring shop; it seemed rather more fluid than that used at Ponder's End. The lamp black was purchased at the same shop, and had been calcined in a covered crucible for about three hours a couple of days before it was used, and when sufficiently cold had been put into a stoppered bottle. A small quantity of coal tar was taken and weighed; it weighed 82 grains. A sufficiency of calcined lamp black was put into a small bottle and weighed, in order to ascertain in the end, by difference, how much had been used in bringing the tar putty up to the proper consistence. The two were incorporated on a table by the use of a spatula of elastic steel; one spatula was three inches broad, the other barely an inch; the broader one was chiefly used. After about 17 minutes' work the tar putty was deemed to have attained the prescribed consistence, which was judged of by comparison with common putty, of which two lumps, of different stiffness, lay on the table. A little more lamp black had been added in this case about a minute and-a-half before finishing.

Some more tar putty was made next day, in a manner in the main the same, being chiefly worked on this occasion with the broad spatula. I will call the tar putty made as described in this and the preceding paragraph "tar putty A," or simply tar putty.

Some tar putty was also made by persons on the defendants' side in imitation of the process they had seen at Ponder's End. The mixing was done on a ground glass plate, with a chisel instead of an elastic spatula, using much force in pressing down the chisel on the putty and spreading out the putty on the plate. The operators relieved one another in the work, which was continued for full an hour and a-half. I will call the putty thus made "tar putty B."

A portion of "tar putty A" was rolled into a ball and squeezed between the thumb and fore-finger. It developed cracks at the edge, and strongly blackened the fingers. The tar putty we had seen at Ponder's End, on being squeezed, came off from the fingers, leaving hardly any stain of lampblack. On rolling a good-sized piece of "tar putty A" between the two hands so as to form a thick roll, holding the two ends of the roll with the fingers of the two hands, and drawing it out a bit it could be pushed back for some way with hardly any force, behaving in this respect like a chain and resembling common putty, which shows the same thing, though less strikingly. The roll of tar putty on being squeezed became more shiny on the surface of the part where thickened, indicating the oozing out of a more fluid portion of the mixture.

Prof. S. Thompson rolled out a filament of tar putty. The rolling was done on ground glass, by means partly of a spatula, partly the finger, the latter being chiefly trusted to when the filament became thin. The filament was made pretty uniform by rolling any part which seemed thicker than the rest. The rolling was continued till the thickness seemed to the eye to match a figure contained in the Edison specification. The finger was dipped into lampblack to keep the tar putty from sticking.

Attempts were made to form coils with this tar putty by winding it round copper spirals formed in imitation of a drawing in the specification, but cracks were developed, and evidently the material would not hold together.

Ten grains of this tar putty were incorporated with two grains of camphor, the two being worked together with a spatula on a table. The mixture passed into the condition of a sticky fluid, and therefore some more lampblack was added and incorporated to make it suitable for working.

Later on a filament was made from the tar putty B, and wound round a copper spiral. The winding was accomplished without difficulty, and cracks were not developed, though the diameter of the spirals was considerably less than that of the bobbins that we had seen at Ponder's End. Moreover, this tar putty, on being squeezed hardly soiled the fingers, and on being a good deal flattened hardly developed cracks at the edge.

2. In Mr. Crookes's laboratory the carbonising was done in ordinary earthenware crucibles of a size to hold three or four fluid ounces. This sort of crucible is, of course, to a certain extent porous, and to test the porosity a fresh one was filled with water and set on four thicknesses of blotting paper. After an hour the paper was wetted over a circle about the size of a crown piece; after four hours the wet patch looked more than three inches in diameter.

100 pieces of vegetable filaments or strips, consisting of card, paper, dark paper, chemically prepared cellulose, wood shaving, thin cotton, thicker cotton, were put into an empty crucible, luted down, the luting dried, the warm crucible put into a furnace, where it was left for an hour and a half. On taking out the crucible the heat was found to have been sufficient to melt copper as well as silver wire. On opening the crucible when cold, nothing was found but white ash.

A similar crucible was similarly filled, with the exception that the vegetable substances were embedded in sand packing. This was fired for an hour only. On opening, a portion, believed to be the card, was found reduced to white ash; another portion was carbonised, but not reduced to white ash. It was not thought necessary to repeat the experiment, because it was not disputed that under the circumstances of the experiment the vegetable substances would have been reduced to ash had the firing been continued for a couple of hours.

A third crucible contained three tar putty horseshoes, and a fourth with platinum ends, and was packed with charcoal. On firing and opening all came out broken, and studded all over with charcoal. On attempting to clean them with a camel's hair pencil the pieces broke up still further. They were, in fact, quite unmanageable.

A fourth contained a single spiral of threaded tar putty, wound on a carbon stick of 2 mm. diameter. On firing and opening it was broken in taking out, and could not be separated from the core.

A fifth contained two horseshoes of camphorated tar putty. After treatment as before these were taken out whole. Most of the charcoal that stuck to them was brushed off with a camel's hair pencil.

As I have mentioned platinum ends, I may say here that the short platinum wires were attached to the ends of filaments in much the same way as we had seen at Ponder's End, only a mixture of coal tar and plumbago was used, instead of a mixture of coal tar and lamp-black. When it was desired to keep the ends of a horse shoe the proper distance apart during firing in the crucible, a thread of melting glass was passed round the platinum ends.

3. The ends of the spiral in the fourth crucible had been provided with platinum wires. These came out altered in appearance, but the memorandum in my note book is, "Platinum not much dulled." In one case shown us the action on the platinum ends had gone so far that the wires were rendered quite brittle; but I cannot recollect for certain whether this was one of those fired in charcoal packing during our visit or before.

4. The effect of coating a filament with an earthy substance was thus tried. Fire clay was rubbed in a mortar, mixed with much water, and the finer parts separated by levigation and collected on a filter. The word "mud" will hereinafter be used to denote the material thus prepared.

Tarred thread was rolled with a little lamp black between glass and glass; then more tar put on, and the thread rolled with lamp black, so as to form a sort of tar putty made on the thread. Four horse shoe filaments were painted with mud, allowed to dry, painted again, and so on till the diameter was two or three times that of the original filament. When dry they were fired as usual in a crucible with charcoal packing.

To mount mud-cased filaments of this kind, the ends of the platinum wires sealed in glass were bent into minute rings, into which the legs of the horse shoe were inserted, and attached by the coal tar and plumbago mixture, which was in contact with both the platinum and the core of the filament; the more effectually as regards the latter if the mud coating happened to be broken off near the end of the horse shoe. The cement was heated, as usual with attachments, to carbonise it.

Two lamps were made with uncoated, and three with mud-coated horse shoes. These lamps were sealed in succession on to the Sprengel pump and exhausted. The bulbs were not heated during exhaustion; the action of the pump was continued till the gauge was sensibly level with the barometer. It was then stopped and the current allowed to pass.

Lamp No. 1 was of uncoated thread. When the current was let on a bright paint appeared at the junction of one leg of the base; an interruption of continuity was almost immediately formed, giving an arc discharge, which was known by the appearance of two very brilliant points, at first almost coincident, and in three minutes the lamp went out, showing a gap of about the 20th of an inch between the end of the leg and the base.

Lamps Nos. 2, 3 and 5 were of mud-coated, tar-puttied thread. These were exhausted in succession, the pump stopped, but the lamp not sealed off from it, but the current let pass while the bulb was still open to the gauge.

When the current was let on to No. 2 it was raised to redness. As soon as the current (0·1 ampère) and the resistance were measured, the current was increased till the lamp got to full brightness, but it died in about 2 minutes after the current was first let on. The bulb was discoloured.

In the case of No. 3, with a current of 4·7 ampères and resistance of 34 ohms, the horseshoe was red. There was a crack in the mud coating extending over about one-third of the whole length. The core seen through the crack was much brighter than the coating. There was a slight depression of the gauge; the bulb remained clear. The pump was worked for a bit to bring the gauge to match the barometer nearly, and the current was then raised to 6·6 ampères. The bulb now began to be a little discoloured, and at 12 minutes from the first letting on of the current an arc discharge was formed, which was known by the formation of bright points which crept along the horseshoe. The lamp went out at 19 minutes from first letting on the current. The gauge was found to be very sensibly depressed at the end, half-an-inch or so. Mr. Crookes mentioned that he had called our attention to the fact that the gauge went down before the arc was formed. I cannot speak to this from my own knowledge, as my attention was taken up with watching the changes of the filament and making memoranda.

A lamp (No. 4) similar to No. 1 was exhausted, but on letting on the current there was a momentary spark and the lamp was destroyed.

Finally, a lamp (No. 5) similar to No. 2 was exhausted, and the current let on. With a current of less than 0·25 ampère the horseshoe was red, the brightness not uniform. The current was increased till an arc discharge began, when two very bright points appeared, one near the base of one leg, the other travelling up the leg. Before that the lamp had been fairly bright, but not nearly of the proper brightness. During the life of the arc the gauge went steadily down; the depression measured at the end 11 mm., indicating a pressure of gas amounting to about $\frac{1}{16}$th of an atmosphere in a volume equal to that of the bulb, plus that of the space above the mercury in the fall tubes and gauge of the Sprengel, not taking account of the narrow connecting tubes.

I have the honour to be, my Lord, your obedient servant,

G. G. Stokes.

June 28th, 1888.

LEGAL.

The United Telephone Company v. Tasker Sons and Co.—On Friday last, in the Chancery Division of the High Court of Justice, Before Mr. Justice Kay, Mr. Aston, Q.C., on behalf of the plaintiff company, moved to vary the minutes of an order made by his lordship when granting an injunction in the action on a former occasion. Mr. Aston stated that when before the Court on a former occasion the motion was for an interim injunction to restrain the defendants Tasker Sons & Co. from using at Sheffield certain telephones which his lordship held were infringements of the plaintiff's rights. The ground of defence set up was this, that the defendant bought a lot of instruments, and that when they were worn out he replaced them with others, and in respect of the replaced ones the Court held the defendant was not entitled to use them. The defendant at that time represented to the Court that there were 52 of these instruments, and an order was therefore made, on the plaintiff undertaking to supply telephones to replace those wrongfully used, that the defendant should be restrained from infringing plaintiff's rights. The plaintiffs were prepared to act upon that undertaking, but it now turned out, according to a correspondence that had taken place, that the defendant gave a wrong number, and required 44 instruments over and above the 52 he previously mentioned. Depending upon the defendant's original statement as to the number, the order had been drawn up in too general terms, and the application to-day was to have the minutes varied to the extent of limiting the number of instruments to 52.

Mr. Justice Kay said the order made appeared to be quite right, and he should certainly not alter it, though he would allow the motion to be taken as one to be relieved from their undertaking. In his order he made no limit, he merely restrained defendant from using any instruments that were a contravention of the plaintiffs' rights.

Mr. Aston: In that case, if they were using 1,000, we should have to supply that number.

Mr. Justice Kay: Yes, that is my order, but you may treat this as a motion to be relieved from your undertaking on the ground that there was a mis-statement in the number.

Mr. Aston said that if he went into the evidence he could show that not only was there a difference in the number, but a difference in the class of instrument. The learned counsel then read the correspondence that had taken place between the parties since the injunction was granted, after which

Mr. Justice Kay asked why the defendants should not be allowed the use of the extra 44 instruments until the trial.

Mr. Aston replied that it was contrary to the principles on which the plaintiffs' firm was being conducted.

Mr. Justice Kay: You have got to consider now the principles on which the business of this court is conducted.

Mr. Aston: Quite so; and we now ask to be relieved from the undertaking.

Mr. Justice Kay: If I relieve you from the undertaking, I shall discharge the injunction.

Mr. Aston: That is a very heavy penalty.

Mr. Justice Kay: I am not going to allow you to put a stop to their business by refusing to supply them with your patent articles on the usual terms. All I ask you to do is to supply them on the usual terms till the trial of the action.

Mr. Aston said that according to his own advertisement the defendant was in a position now to continue his present business, but plaintiffs did not wish him to extend it.

Mr. Justice Kay said he would not allow the business to be extended, but when the order was made he intended to put the plaintiffs under an obligation to supply upon their own terms, either by sale, hire, or loan at their own choice, sufficient to replace those defendant was at present using.

Mr. Aston said that at that time, thinking there were only 52, he advised his clients to accept the terms, and his clients acceded, but now they discovered a different state of circumstances.

Mr. Justice Kay: That is, you would put a stop to the defendant's business, if you could, until the trial.

Mr. Aston said the plaintiffs were prepared to give the defendant the 52, but would not have him extend his business, therefore the plaintiffs could not undertake to supply the extra 44.

Mr. Justice Kay: If you ask to be relieved of the undertaking I must relieve the other side of the injunction.

Mr. Aston: I must accept your lordship's decision to relieve us of the undertaking.

Mr. Justice Kay, in delivering judgment, said:—In this case an order was made upon a motion which came on before me the other day, granting an injunction restraining the defendants, who are in possession of a business of an electric telephone agency, from using in that agency any receivers which were infringements of the plaintiffs' patent. There are questions raised which have to be tried at the trial of the action as to the validity of the patent, and so on. The injunction sought for is to restrain the use in the meantime, and it seemed to me fitting that under all the circumstances the use should be restrained in the meantime, which is an order the court only makes in exceptional cases. Then it was suggested that the object was really a collateral object—that the plaintiffs were themselves setting up a similar agency in Sheffield. and that the real object of the motion was to destroy the business of the defendants in order to encourage the plaintiffs' own business in that town. Under these circumstances I suggested to the plaintiffs, as a test of their good faith in the matter, that it would be proper that they should, upon the granting of any such injunction, enter into an undertaking that they would supply on their usual terms. The minutes are very accurate indeed as to that—that they would supply to the defendants, until judgment in this action, or further order, on the usual terms as to costs or otherwise, by way of hire, sale, or loan, or letting at their pleasure so many instruments as shall be sufficient to supply the telephones now in use which this order will prevent the defendants from using. It seemed to me, under all the circumstances, that would have been a very fair order, because it is impossible to see how it can harm the plaintiffs in any way, unless it interferes with the rival business which they are setting up, and was one they ought to accede to, and they did accede to. The injunction accordingly went; the order was made in the largest terms to restrain the defendants, until judgment or further order, from making, using, or selling, or otherwise disposing of any telephones which are an infringement of the plaintiffs' patent in the writ of summons mentioned. It is in the largest possible terms restraining any kind of infringements; and, of course, that undertaking applied to every instrument the use of which is at the time thereby restrained. Then this contest is raised before me: 'Well; but we are not going to supply them with instruments to extend their business.' Certainly not. It is the instruments *now in use*—the instruments *they are now using*, and which this injunction would prevent them from using. Upon that, I think, the order is quite explicit—sufficient to supply the place of the telephones now in use. The order is very carefully worded. There was evidence at that time that there were 52 of these instruments in use which this order would prevent their using. A correspondence has now been read which has taken place since this order was made, in which the defendants say they have discovered there are other instruments to which this order would apply. Then they ask them to supply 96; that is, the 52 plus 44. Then there is a further correspondence, saying that these instruments were supplied upon a guarantee that they were royalty paid instruments, but since that the defendants have reason to believe, and have asserted, that that is not so. I have no evidence before me showing that in the least degree that is an untrue statement. There is nothing to suggest that in making that statement they have discovered since the hearing of the motion there has been any bad faith on the part of the defendants. Of course if there had been that might have involved consideration, and accordingly believing, as I always do unless I have reason to suspect the contrary, that the litigants on both sides are speaking the truth—and, indeed, no suggestion is made before me to make me doubt the truth of that—the form of this injunction as granted would prevent the use of the 44 instruments as well as the 52, and the undertaking to supply instruments in the place of those now in use (these are the words of the injunction, meaning, of course, at the time of the injunction) would oblige the plaintiffs to supply the 44 instruments as well as the 52. Now if the plaintiffs are acting in good faith, I cannot conceive any reason why they should not continue that undertaking. If the purpose of this motion is not to destroy a rival business, there is no reason why they should not continue that undertaking. The undertaking as to the 52 was given—that shows there is nothing in the world to prevent their giving it as to the 96, and why the undertaking should not continue as to the 44 extra which the defendants are by the order prevented from using I cannot understand, nor has any reason at the Bar been suggested, therefore I come to the conclusion, and it is the only conclusion to which I *can* come, that this is a device on the part of the plaintiffs to destroy *brevi manu* before the trial of the action a rival business. That I shall not allow. Accordingly if the plaintiffs now insist upon the right to withdraw from their undertaking, it can only be upon the terms that the injunction from this moment is discharged, or that the operation of it is suspended. Therefore I give the plaintiffs the choice if the plaintiffs choose to withdraw from their undertaking—and not to extend it—not to allow it to include, as in terms it does, these 44 instruments which the defendants now contend are within the same category as to the question of infringement as the 52 mentioned at the hearing of the motion, if they now insist that their undertaking shall not extend to them, then I say the conditions upon which this injunction was granted fails, and I refuse to continue the injunction. The matter is entirely for them. I leave it to them. The order which I now make is, that if the plaintiffs insist on withdrawing from the undertaking it can only be upon the terms that the injunction is no longer enforced. This motion is brought on quite irregularly. It is a motion to vary the minutes of the order; that motion can only be entertained when the minutes of the order do not correctly express the order the Court made, and there is no ground for saying these minutes do not correctly represent the order the Court made; they are exactly the order the Court made. I am quite satisfied the plaintiffs would be the last persons to be satisfied with the statement that only 52 instruments were an infringement. They sought the injunction in the largest terms to prevent the infringement of any, not of 52, and the injunction was granted in those terms to prevent the use of any instruments which were an infringement of the plaintiffs' patent, and it was part of the order that that injunction should only be granted upon their giving that undertaking, therefore the motion in the form in which it was was irregular, but I have allowed it to be made as a motion to ask the leave of the Court to withdraw from the undertaking that was given, and I grant that leave upon the terms I have stated.

Swaby v. Watt and others.—(Before Mr. Justice Stirling).—The plaintiff in this case was a director of the Maxim-Weston Electric Company, and he moved the Court that the defendants might be restrained—(1) from forfeiting or cancelling 400 shares in the capital of the company held by him; (2) from allowing any notice, minute, or entry alleging such forfeiture or cancellation to remain on the register or in the minute book of the company; (3) that the defendant Howell might be restrained from acting as a director of the company; and (4) that the defendants might be restrained from excluding the plaintiff from meetings and from interfering in any way with his acting as a director of the company. The defendant, Mr. Hugh Watt, M.P., was the chairman of the company, and the defendant, Mr. George Howell, M.P., claimed to have been duly appointed a director. The facts of the case appear sufficiently from the judgment.

Mr. W. Pearson, Q.C., and Mr. Gasdar appeared for the plaintiff; Mr. Graham Hastings, Q.C., and Mr. Alexander Young for the defendant Howell; and Mr. Buckley, Q.C., and Mr. Robert Wallace for the company.

Mr. Justice Stirling, in giving judgment, said:—The evidence adduced in this case shows that some very singular transactions have occurred in this company. In the first place, the plaintiff, who is a director of the company, asks to be relieved from an alleged forfeiture of his shares, and that alleged forfeiture is certainly the most curious that I have ever heard of. It is provided by Article 23 of the company's articles of association that—

"If any member fails to pay all or any part of any call or instalment on or before the day appointed for the payment of the same, the directors may at any time thereafter, during such time as the call or instalment remains unpaid, serve a notice on him requiring him to pay the same, together with any interest and any expenses that may have accrued or been incurred by reason of such non-payment. The notice shall name a further day (not less than 14 days from the date of the notice) and place or places on and at which such call and instalment and all interest and expenses that have accrued or been incurred by reason of such non-payment are to be paid. It shall also state that, in the event of non-payment at or before the time and at the place appointed, the shares in respect of which such call was made or instalment is payable will be liable to be forfeited."

And Article 24 provides that—

"If the requisitions of any such notice as aforesaid are not complied with, any shares in respect of which such notice has been given may at any time thereafter before payment of all calls or instalments, interest, and expenses due in respect thereof, be forfeited by a resolution of the directors to that effect."

It appears that disputes having occurred between Mr. Watt and Mr. Swaby, on March 19th, 1888, the solicitors of the company wrote the following letter to Mr. Swaby:—

"We are instructed by the Maxim-Weston Electric Company, Limited, to apply to you for payment of 5s. per share on the 2,000 shares which on your application were allotted to you in October, 1886. And we have to acquaint you that unless the amount be paid to us, together with interest at 10 per cent. per annum from the time when the respective calls became due, proceedings will be taken against you for the recovery thereof and without further notice to you."

Now that, continued his Lordship, was not in any way a notice in accordance with Article 23. It no doubt required him to pay the instalments alleged to be due, but it did not name a further day upon which such payment was to be made, nor state that, in the event of non-payment, the shares would be liable to be forfeited. But the further proceedings were even more extraordinary still. The letter of March 19th related to 2,000 shares, but Swaby denied that he was the owner of those shares. That was not seriously contested. It appeared that they were allotted to him in October, 1886, and on February 21st they were transferred to Watt, and this notice was not given until March 19th, 1888—more than a year after the transfer. In addition to the 2,000 shares, Swaby was also entitled to 400 fully paid shares. Now, by the articles shares were only forfeitable if the member holding them failed to pay calls on the day named. These 400 shares being fully paid up it was difficult to see how they could be forfeited at all. But on April 6th, 1888, this minute appeared in the minute-book of the board of directors:—

"The solicitors of the company reported that Mr. Louis Swaby had paid nothing with regard to the 2,000 shares applied for and allotted to him as against principal, interest, or damages resulting from non-fulfilment of contract, and it was resolved that the 400 shares standing in his name in the register of the company be and they are hereby forfeited, and that intimation be accordingly sent to Mr. Swaby informing him that, as he is no longer a shareholder in the company, he is neither entitled to act as a director nor to have the privileges of a shareholder."

And on April 9th the secretary of the company wrote to Mr. Swaby as follows:—

"I am directed to inform you that your 400 shares have been cancelled for claims due by you to the company, owing to non-payment of the 2,000 shares applied for and allotted to you, and against which you have paid neither principal nor interest. You having accordingly ceased to hold any shares in this company, are neither entitled to act as a director nor to the privileges of a shareholder."

It appeared also that there was an entry in the register of the company opposite to the 400 shares to the effect that those shares were cancelled by resolution of the board. It was not, said his lordship, at all extraordinary that the plaintiff should have felt himself aggrieved, or that he should have brought this action, and when the matter came to be discussed counsel for the defendants did not oppose that part of the application for an injunction. Then, on April 29th, in pursuance of that minute, Watt and Howell treated the plaintiff as no longer holding any shares or as being a director. The sole ground for that was the alleged forfeiture; but that was a nullity, and the defendants had no right to prevent the plaintiff from acting as a director, a position which he was entitled to hold. There appeared to be a struggle going on between the plaintiff and Watt and the shareholders who supported them respectively. The disputes were of a nature to be settled by the shareholders themselves, and his lordship thought that early measures should be taken to bring the matter before them. Meanwhile, he had to determine the legal position of the parties. It appeared from the directors' report that Mr. Watt and Mr. Brown retired by rotation, and on March 2nd, 1888, the following minute appeared in the minute book:—

"Mr. John Brown intimated that, owing to the state of his health, he felt compelled reluctantly to resign his seat at the board, and the secretary was instructed to write a letter of condolence to Mr. Brown, and to intimate the sincere regret of his late colleagues at the step which he felt compelled to take."

It was contended that that was a record of what took place at the meeting. Now, the articles provided that a director intending to resign should tender a written resignation at a board meeting, and on the acceptance of his resignation his office should be vacant. It was quite plain that Brown did not tender any written resignation at a board meeting, and that no resignation was accepted. His lordship was not sure that the minute was a *bona fide* record of what took place. There were suspicions in his mind which had not been removed by what had been told him by the secretary of the company in the box. The next meeting purported to appoint Mr. Howell a director of the company. On March 16th, 1888, this minute appeared in the book:—

"Present, Hugh Watt and George Howell.—A letter was read from Mr. L. Swaby, intimating his inability, owing to serious indisposition, to be present, but stating that he was agreeable that Mr. Howell, M.P., should be a director of the company. The chairman then proposed Mr. Howell's election, and requested that gentleman to attend. Mr. Howell attended, and, having been informed by the chairman that he had been appointed a director of the company, returned thanks for his appointment, and took his seat at the board."

It was perfectly plain that there was no appointment. One man could not constitute a meeting, and the articles put it beyond doubt, because they required two directors to be present before any business could be transacted. His lordship then referred to further minutes of meetings, remarking that they were irregularly entered, and came to the conclusion that Mr. Howell had never been properly elected a director of the company at all. He then referred to the proceedings at a meeting convened by a circular issued by the chairman, and remarked that there was nothing in the articles authorising the chairman to call meetings. His lordship then read what purported to be the minute of a meeting held on the 11th of May, 1888, at which the chairman expressed his opinion that Mr. Swaby was not entitled to be a director of the company, and the minute further stated that the directors approved a notice sent to Mr. Swaby in terms of the board's resolution contained in the minutes of the 6th of April. So, said his lordship, they purported to exclude the plaintiff altogether from acting as a director. That was one of the most surprising minutes his lordship had ever heard of. Could he believe it, after the melancholy exhibition which he had seen in the witness-box? It was a mere story got up by Watt in order to protect his position and to justify his high-handed proceedings with reference to the forfeiture of the plaintiff's shares. Taking that view, his lordship thought Howell had not been duly elected, and the plaintiff was entitled to an injunction in the terms of his notice of motion.

EFFECTS OF DIFFERENT POSITIVE METALS, &c., UPON THE CHANGES OF POTENTIAL OF VOLTAIC COUPLES.*

By Dr. G. GORE, F.R.S.

[ABSTRACT.]

IN this research numerous measurements were made, and are given in a series of tables of the effects upon the "minimum point of change of potential of a voltaic couple in distilled water" (Roy. Soc. Proc., June 14th, 1888), and upon the changes of electromotive force attending variation of strength of its liquid" (*ibid*), obtained by varying the kind of positive and of negative metal of the couple, and by employing different galvanometers. The measurements were made by the method of balance through a galvanometer by the aid of a suitable thermo-electric pile (Birmingham Philosophical Society's Proceedings, Vol. IV., p. 130. The *Electrician*, 1884, Vol. XI., p. 414). The kinds of galvanometer employed were an ordinary astatic one of 100 ohms resistance, and a Thomson's reflecting one of 3,040 ohms resistance.

The following were the proportions of hydrochloric acid (H Cl) required to change the potential of different voltaic couples in water :—

TABLE I.—HYDROCHLORIC ACID.

	Astatic Galvanometer. Between			Reflecting Galvanometer. Between		
Zn + Pt.	1 in 9,300,000	and	9,388,185.	1 in 15,500,000	and	23,250,000.
Ed + Pt.	1 ,, 574,000	,,	637,000.	1 ,, 1,162,500	,,	1,550,000.
Mg + Pt.	1 ,, 516,666	,,	574,000.	1 ,, 775,000	,,	930,000.
Al + Pt.	1 ,, 12,109	,,	15,000.	1 ,, 43,568	,,	46,500.

With iodine and the astatic galvanometer the following proportions were required :—

TABLE II.—IODINE.

Zn + Pt.	Between	1 in	3,100,000	and	3,521,970.
Mg + Pt.	,,	1 ,,	577,711	,,	643,153.
Cd + Pt.	,,	1 ,,	200,431	,,	224,637.

With bromine and the astatic galvanometer :—

TABLE III.—BROMINE.

Mg + Pt.	Between	1 in	310,000,000	and	344,444,444.
Zn + Pt.	,,	1 ,,	77,500,000	,,	84,545,000.
Cd + Pt.	,,	1 ,,	3,470,112	,,	3,875,000.

The magnitudes of the minimum proportions of bromine required to change the potentials of the three couples varied directly as the atomic weights of the three positive metals.

With chlorine the following were the minimum proportions required :—

TABLE IV.—CHLORINE.

With the Reflecting Galvanometer.

Mg + Pt.	Between	1 in	27,062,000,000	and	32,291,000,000.

With the Astatic Galvanometer.

Mg + Pt.	Between	1 in	17,000,000,000	and	17,612,000,000.
Zn + Pt.	,,	1 ,,	1,264,000,000	,,	1,300,000,000.
Zn + Au.	,,	1 ,,	518,587,360	,,	550,513,022.
Cd + Pt.	,,	1 ,,	8,733,585	,,	9,270,833.
Zn + Cd.	,,	1 ,,	55,436	,,	76,467.

In the case of chlorine, as well as that of bromine, the magnitudes of the minimum proportions of substances required to change the potential of magnesium-platinum, zinc-platinum, and cadmium-platinum varied directly as the atomic weights of the positive metals.

The examples contained in the paper show that the proportion of the same exciting liquid necessary to disturb the potential of a voltaic couple in water varied with each different positive or negative metal, and that the more positive or more easily corroded the positive metal, or the more negative or less easily corroded the negative one, the smaller usually was the minimum proportion of dissolved substance necessary to change the potential.

By plotting the results in all cases it was found that the order of change of potential, caused by uniform change of strength of liquid, varied with each positive metal.

The results also show that the degree of sensitiveness of the arrangement for detecting the minimum point of change of potential depends largely upon the kind of galvanometer employed.

As a more sensitive galvanometer enables us to detect a change of potential caused by a much smaller proportion of material; and as the proportion of substance capable of detection is smaller, the greater the free chemical energy of each of the uniting bodies (Royal Society Proceedings, June 14th, 1888), it is probable that the electromotive force really begins to change with the very smallest addition of the substance, and might be detected if our means of detection were sufficiently sensitive, or the free chemical energy of the uniting bodies was sufficiently strong.

THE VOLTAIC BALANCE.

By Dr. G. GORE, F.R.S.

A NEW and simple lecture experiment. Take two small clean glass cups containing distilled water, simultaneously immerse in each a small voltaic couple, composed of either unamalgamated magnesium or zinc with platinum, taking care that the two pieces of each metal are cut from the same piece and are perfectly clean and alike. Oppose the currents of the two couples to each other through a sufficiently sensitive galvanometer, so that they balance each other and the needle does not move. Now dip the end of a slender glass rod into a very weak aqueous solution of chlorine, bromine, iodine, or hydrochloric acid, and then into the water of one of the cups. The voltaic balance is at once upset, as indicated by the movement of the needle, and may be shown to a large audience by means of the usual contrivances.

The chief circumstance to be noticed is the extremely great degree of sensitiveness of the arrangement in certain cases. This is shown by the following instances of the minimum proportions of substance required to upset the balance with an ordinary astatic galvanometer of 100 ohms resistance and with a Thomson's reflecting one of 3,040 ohms resistance :—

1. *Zinc and Platinum with Iodine.*—With the astatic galvanometer between 1 part of iodine in 3,100,000 and 3,520,970 parts of water.

2. *Zinc and Platinum with Hydrochloric Acid.*—With the astatic galvanometer between 1 in 9,300,000 and 9,388,185 parts ; and with the reflecting one between 1 in 15.500,000 and 23,250,000 parts.

3. *Magnesium and Platinum with Bromine.*—With the astatic galvanometer between 1 in 310,000,000 and 344,444,444 parts.

4. *Zinc and Platinum with Chlorine.*—With the astatic galvanometer between 1 in 1,264,000,000 and 1,300,000,000 parts.

5. *Magnesium and Platinum with Chlorine.*—With the astatic galvanometer between 1 in 17,000,000,000 and 17,612,000,000 parts ; and with the reflecting one between 1 in 27,062,000,000 and 32,291,000,000 parts of water.

Every different soluble substance requires a different proportion, and with unlike substances the difference of proportion is extremely great. With solutions of neutral salts the proportion of substance required to upset the balance is large—for instance, with chlorate of potassium, a zinc-platinum couple, and the astatic galvanometer, it lay between 1 part in 221 and 258 parts of water.

The degree of sensitiveness of the balance is usually greater, the greater the degree of chemical affinity the dissolved substance has for the positive metal, and the less it has for the negative one.

By first bringing the balance with a magnesium-platinum couple and the astatic galvanometer nearly to the upsetting point, by adding 1 part of chlorine to 17,612 million parts of water, and then increasing the proportion to 1 in 17,000 millions, the influence of the difference, or of 1 part in 500,000 millions, was distinctly detected.

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* Read before the Royal Society, June 21st, 1888.

NOTES.

The Paris Opera Installation.—The current number of *La Lumiere Electrique* continues a description of the lighting arrangements at the Paris Opera House. The article chiefly deals with the regulators, rheostats, &c. It appears that the contract between the State and the Edison Company is for a term of 10 years. The company is entirely responsible for the lighting, and is paid at the rate of 1,130 francs for every performance, and 2,000 francs for every ball. The payment is based upon a lighting consisting of 5,018 lamps of 10 candles, 888 lamps of 16 candles, 8 Pieper regulators, and 12 Jablochkoff candles. The staff is supplied by the Edison Company, but is paid by the direction of the Opera.

The Spanish Electric Lighting Laws.—Two delegates have been sent from Spain to France and England for the purpose of investigating and reporting upon the different systems of lighting. Our contemporary *La Lumière Electrique* remarks, that as these gentlemen have but very vague ideas on the subject, the journey will perhaps prove one more of pleasure than of real utility.

Electric Lighting in South Africa.—The Durban Corporation has decided to accept Mr. George Ireland's tender for the erection of electric light plant in the Town Hall, subject to the distinct understanding that the whole of the work requisite for a complete installation of light be completed without any extras whatever, and to the satisfaction of the borough engineer.

Central Stations in Vienna.—Several leading manufacturers in Mariahilf and Neubau, Vienna, intend to erect a central electric light station for lighting both these districts. The estimated cost is £70,000, of which about one-third has already been subscribed, and it is not expected that there will be any difficulty in raising the balance among the commercial firms in the locality.

Birmingham and the Electric Light.—The preliminaries for bringing the electric light into general use in Birmingham are assuming more definite shape. Messrs. Chamberlain and Hookham have notified the Town Council that it is their intention during the present year to apply to the Board of Trade for a provisional order authorising them to supply electricity for public and private purposes.

Mill Lighting in Devonshire.—Last Saturday evening the electric light was installed in the large mills of Messrs. Vicary Bros., tanners, at Bradley, Newton Abbot. Lower Bradley Mill, used for the purpose of removing the wool from the foreign sheep skins, and in which upwards of a hundred persons are employed, has been fitted throughout with the electric light on the incandescent principle. About eighty-two lamps have been fixed, most of them being of sixteen-candle power, but twenty lamps are of fifty-candle power. They are distributed all over the building, in the three engine rooms, and the various workshops, where both men and women are employed. The current is supplied by a hundred-light dynamo, made in a very compact form from the design of the installing electrician (Mr. Radcliff). It is situated on the first floor, and is driven by one of Messrs. Vicary's steam engines, used in connection with the ordinary work of the mills. The result is that a safer and better light has been obtained at a much cheaper price than that hitherto paid. Mr. Radcliff has offered to light up a portion of Torquay or any of the hotels on the same conditions, and has undertaken to fix the electric light for the Art and Industrial Exhibition to be held in the Torquay Winter Gardens the first week in August.

Kensington and the Electric Light.—Some discussion ensued at the last meeting of the Kensington Vestry on the application of the solicitors to the Kensington Court Electric Lighting Company, requesting the sanction of the Vestry to a transfer of the licence at present held by them to a new company. Ultimately the matter was referred to the Parliamentary Committee.

Electric Lighting at the Brussels Exhibition.—So far the most successful installation at the Brussels Exhibition, according to *Industries*, is that of the Thomson-Houston Company, comprising 78 arc lamps, the next best being that of the Société Bouckaert-Schuckert. The Pieper system has proved the worst, and the Brush Company's has not made a favourable impression. This has been due to the inferiority of the engines employed. M. Pieper has used a Van der Kerchove twin engine, which runs irregularly, and the Brush Corporation an engine by M. Van Acker, of Brussels, which has proved equally unsuitable. The Thomson-Houston Company employs an Armington-Sims engine of 84 H.P., driving two dynamos of 45 and 42 lamps capacity respectively. This engine works very well. M. Pieper is going to adopt an Armington-Sims engine instead of his present one. Some small installations will probably yet be put up in and around isolated buildings in the gardens, the motive power being supplied from some engines in the galleries of the machinery hall. The internal lighting at the Exhibition is throughout very good. Messrs. Ganz & Co. show their transformer system in practical operation; and M. Khotinsky has a nice exhibit of incandescent lamps supplied by batteries. There is a fair display of different types of direct driven dynamos, with high speed engines.

The Proposed Electric Lighting at Bournemouth.—The movement for introducing the electric light in a permanent way into Bournemouth is making considerable progress, and it is anticipated that the new Electric Light and Power Company which has been formed will be enabled to commence operations very shortly. The system to be employed is the Ferranti.

Domestic Lighting.—Mr. A. Kingsmill is having the electric light fitted throughout his new house at Bentley Priory. A horizontal locomotive boiler and vertical engine by Messrs. Marshall Sons & Co., will be employed to drive an Elwell-Parker dynamo in conjunction with 27 accumulators. The installation has been entrusted to Messrs. Drake & Gorham.

Dublin and the Electric Light.—At the meeting on Monday of the Dublin Corporation, Mr. Healy gave notice that at the next meeting he would ask Mr. Robinson, chairman of the committee of the whole house on electric lighting, what progress had been made by the committee; the date when an order was given to apply for a licence; if that licence was obtained; and if not, to explain the cause of delay; and as the committee had been sitting from time to time from May 2nd, 1887, if it would not be desirable to show more energy in the matter. The Town Clerk said a letter had been received from the Gas Company, informing the council of their intention to apply for a Provisional Order authorising them to supply electricity within the municipal boundaries of the city of Dublin. The Parliamentary agents, Messrs. Badham and Gore, had written suggesting that representatives of the Corporation should attend at London the next day to meet representatives of the Gas Company in conference. This suggestion met with approval.

Nottingham and the Electric Light.—Messrs. W. T. Glover & Co., of Salford, have notified the Urban Sanitary Authority and the Vestry of Nottingham that application will be made on or before December 21st next, by memorial to the Board of Trade, for a provisional order to authorise them (Messrs. W. T. Glover & Co.), or a company to be formed for the purpose, to supply electricity for any purpose within the area of the jurisdiction of the bodies named.

Telephonic Charges at Hull.—At a meeting of the Council of the Hull Chamber of Commerce and Shipping, on Tuesday, a letter was read from the Postmaster-General on the subject of telephonic charges at Hull. He had made calculations, and was convinced "that there is no room at present for a reduction. At the same time I may say that when the patents have expired it may be possible for the Department to obtain telephones at a much lower price, and it would then be only right to reconsider the charges for Telephone Exchange wires, and to give the public the benefit of the reduction."—Ald. Seaton considered the reply was very unsatisfactory. It seemed to him that Mr. Raikes, like other Postmaster-Generals, was completely under the thumb of the staff of officials about him, and that they declined to commence with the reform of the system which was so desirable for the benefit of the trading community. His experience showed him that St. Martin's-le-Grand was simply an Augean stable that needed a thorough purgation. It was decided to thank Sir A. Rollit for obtaining this expression from the Postmaster-General, and also to request him to call attention to the matter whenever an opportunity presented itself in the House of Commons.

Questionable Advantage of the Telephone.—A total extinction of all the lights fed from the central station in the Friedrichstrass, Berlin, occured lately, owing to the breaking of one of the cables. The lights had not been extinguished for more than a few seconds when the central telephone station received 300 simultaneous calls for communication with the electric lighting company.

Plymouth and the Telephone—Two Pictures.—The Post Office opened a telephone exchange at Plymouth in the latter part of 1881, which in its palmiest days never exceeded 45 subscribers; now it is closed and dead, and the whole of the instruments supplied to their subscribers, except two which remain for private telegram lines, have been removed. The Western Counties and South Wales Telephone Company opened at Plymouth in February, 1855, and the number of subscribers at this date is 225; this includes those who were originally Post Office subscribers. The subscribers to the Post Office exchange at Cardiff and Newport are gradually following in the wake of their friends in Plymouth. The Post Office exchange at Cardiff has 36 subscribers, the highest ever reached; and in Newport they have 42 subscribers. The Western Counties Company opened in Cardiff in December, 1885, and has 84 subscribers at present. In Newport it opened in January, 1886, and has now 51 subscribers.

Telephony in Vienna.—The first telephone station under the direct control of the Government has been that established in the Rotunda, and steps have now been taken for the erection of six more stations in the town of Vienna itself. These will eventually be connected with the telephone exchanges in Baden, Vöslau, Wiener, Neustadt, and Reichenau. A project is also under consideration for the establishment of a long distance telephone system between Prague and Vienna.

Telephonic Communication between Canterbury and Dover.—On Monday the work of erecting the trunk line for the South of England Telephone Company, between Dover and Canterbury, was practically completed. All that now remains to be done is a short length at the Dover end which has been delayed on account of special permission having to be obtained from the Dover and Deal Railway Company for the line to cross Crabble Bridge.

A Telegraphic Operator Killed.—M. Gillet, a telegraphic operator at the Vaisc Station, Lyons, was killed by lightning while transmitting a message.

A Marvel of Telegraphy.—The *Melbourne Telegraph* in a recent issue says:—We are living in an age of miracles without being aware of it. Within two hours of the time of the first innings of the Oxford cricket match closing, the *Daily Telegraph*, recording the event, was selling in the streets of Melbourne! This is a feat of telegraphy that probably beats all former records, and is worthy of note, by the way, as a reminder of the astonishing performances of modern science, which directs the lightning as the slave of man's will, and places the two ends of the world almost within speaking distance. The cricketers closed their innings at Oxford amid cheers for the wonderful skill of Ferris and Turner, and while the players were still on the ground continuing the contest, the news were flashed across the body of the planet, put in type, printed, and distributed in living print during the advance of a hundred and twenty minutes.

Lightning and Telegraph Instruments.—During a thunderstorm, accompanied by lightning, last week, one of the female telegraph operators at Ennis, Miss Maggie Sheridan, while working an apparatus in the post-office, was observed to reel, at the same time uttering loud screams, and finally to fall to the floor. Inquiry elicited the fact that she had received an electric shock in consequence of the lightning having come into contact with the wire outside and been conducted into the office to the instrument which she was operating. The young lady shortly afterwards recovered.

Interruptions and Repairs to Land Lines and Cables.

Line or Cable.	Interrupted. 1888.	Repaired.
Land line.—Saigon-Bangkok ...	31st May ...	Still interrupted.
Cable.—Punta Rassa-Key West	4th June ...	5th June, 1888.
Land line.—Moulmein-Bangkok	28th May ...	11th „ „
„ „ „	12th June ...	Still interrupted.
Cable.—Bolama-Bissau ...	1st May ...	Still interrupted.
Cables (both).—Port Darwin-Java ...	„ June ...	Still interrupted.
Cable.—D.U.S. Atlantic ...	„ „ ...	Still interrupted.
„ Galveston-Tampico ...	„ „ ...	Still interrupted.

Anglo-French Submarine Cables.—A telegram from Paris on Tuesday said that the *Matin* of that morning stated than an agreement between England and France had just been signed for the direct working by the British and French Governments, on joint and mutual account, of the submarine cables uniting the two countries, the arrangement to come into force on January 1st, 1889. The *Matin* adds that the tariff is to be reduced to 20 centimes per word, and that a direct line is to be established between Havre and Liverpool.

Australian Cables Broken.—The Eastern Extension Telegraph Company notified at the beginning of the week the interruption of its two cables between Java and Australia. A repairing steamer left Singapore immediately to effect repairs, and it was expected that communication will be restored in about 10 days. In the meanwhile provision will be made for conveying telegrams for Australia by steamer from Java.

The West India Cable.—There seems to be a great deal of dissatisfaction in the West Indies with the service of the West India and Panama Telegraph Company, and great reluctance to pay the subsidies which render it possible for that company to continue in operation. A Jamaica paper which has reached us contains a spiteful attack upon the administration of the company, and says:—"No one, so far as we know, sees the necessity for its existence, except those who have a direct pecuniary interest in it, and we have yet to learn that it is the duty of any Government to apply the public money to maintain inefficiency and something worse in existence. It is at once mischievous and absurd, as it is certain that if the company did collapse in the withdrawal of the subsidies, its place would be taken by another, and the public would be much better served, possibly without any subsidy at all."

Reckenzaun's Electric Boat in America.—In its issue of June 23rd the New York *Electrical World* gives a full description with excellent illustrations of the electric launch *Magnet*, which was designed by Messrs. Anthony and Frederick Reckenzaun and which is considered the first successful vessel of this class produced in the United States. Judging by the notices of numerous daily papers the running of this boat on the Passaic river and round the coasts between Newark N.J. and New York City, seems to have caused a considerable amount of excitement and curiosity. This surprises us somewhat, because on this side electric launches have become an every day occurrence and we have seen a number of them on the river Thames since Mr. A. Reckenzaun launched the *Electricity* nearly six years ago. In many things the Americans are ahead of us, but in matters of navigating the waters we still hold our own, even where electricity is concerned. The *Magnet* is a wooden boat, 28 feet long, 6 feet beam, and 3 feet deep, drawing 30 inches of water aft. Her propelling apparatus consists of 56 cells, made by the Accumulator Company of New York, weighing together 2,400 pounds, which supply the current to a Reckenzaun motor and screw propeller of 420 lbs. weight and capable of working up to 10 H.P. There are two switches at the command of the pilot, one for starting, stopping, and reversing, and the other for throwing the battery in series of 56, or in two parallel series of 28 cells each. With the accumulators in parallel the motor and screw make about 540 revolutions per minute when the boat makes an average speed of six miles an hour, and it has actually been run for a distance of over 60 miles with one charge, during a continuous voyage for 10 hours. With all the cells in series, a speed of 10 miles an hour has been attained. The current at the slow speed averages 33 ampéres; at the maximum speed nearly 70 ampéres. Those who know the nature of the sea between the Passaic river and East river, will appreciate the seaworthiness of this craft which often plies between the ports mentioned. The *Magnet*, which was built in Newark, U.S.A., is considered the most carefully constructed, and best finished electric launch afloat, and yet its cost did not exceed 1,500 dollars.

Errata.—In our article on "Spectro-Telegraphy" some misprints occurred. In the middle of the first column "*All the two and three-flags signals and the* $\frac{2}{18{,}960}$ $\frac{1}{\textit{first}}$ *of the four flags*" . . . . should read as follows:—"*All the two and three-flags signals and the first* 18,960 *of the four flags*" . . . . In the second column is printed: "the signal can be *made* by anyone," instead of "the signal can be *read* by anyone."

Mr. Watt's Libel Action.—The jury on Wednesday returned a verdict for the defendant in the action in which Mr. Hugh Watt, M.P., sought to recover heavy damages from Dr. Cameron, M.P., for an alleged libel in the *North British Daily Mail*, consisting of an accusation of plagiarism in a lecture delivered by Mr. Watt.

Fire.—On Tuesday night the premises of Messrs. W. D. Berry and Sons, electrical engineers, Brook Street, Huddersfield, were partially destroyed by fire. On the same day one of Mr. Berry's sons met with a fatal accident at Barnsley.

Telegraph and Telephone Tenders.—Tenders are required for the erection and maintenance of telegraph and telephone systems on the dock and railways for the Barry Dock and Railways Company. Specification, with form of tender and full particulars, may be obtained on application at the General Manager's office, Vienna Chambers, Cardiff.

Removal of Fibroid Tumours by Electricity.—In conjunction with an experienced gynæcologist, Dr. I. G. Douglas, of Bournemouth, Mr. William Lynd is about to introduce Dr. Apostoli's treatment of uterine tumours in the "English Riviera." The first patient will be operated upon early in July with the special instruments made by Coxeter & Son, of Grafton Street, London, W.C., who are, we believe, the sole manufacturers of the particular kind of apparatus used by the celebrated French gynæcologist for the electrical treatment of various phases of uterine disease.

Telephone Catalogue.—An excellent illustrated catalogue has been sent to us by the Consolidated Telephone Construction and Maintenance Company, which holds the exclusive licence to manufacture telephones of the Bell, Edison, Blake, Gower-Bell and Hunnings systems in the United Kingdom. The catalogue gives descriptive particulars of the various telephones, stating for what kind of service each one is specially adapted and recommended, such as military and mining purposes, diving operations, hotels, private houses, offices, stables, ships, &c. Directions for fixing and working are also given, as well as valuable hints on a number of other points. Each type of instrument is beautifully illustrated, and the book altogether has been carefully got up, and is well printed. A useful appendix gives a code, by the use of which enquiries and orders per telegraph can be sent at a minimum cost.

Robey & Co.'s Engines.—Messrs. Robey & Co. exhibit at the Royal Agricultural Show at Nottingham, amongst other specimens of their manufacture, one of their well-known compound "Robey" engines, which are being largely used in electrical installations, and for driving machinery where perfectly steady running is required, and for which work it is specially well adapted. It is very powerful for the space occupied; works with perfect regularity with very varying loads; and is extremely economical in fuel, consuming under 2 lbs. of best Welsh coal per indicated horse-power per hour. The working parts are perfectly balanced so as to run safely at high speed; they have large wearing surfaces of ample size and run cool with heavy loads, and the lubrication is suitable for long runs. The boilers of these engines are made to work with 150 lbs. steam pressure, are made wholly of Siemens-Martins steel and are carefully constructed by the most perfect machinery, every rivet hole being drilled in position by special tools, and the horizontal seams butt-jointed and plated inside and out with double rivetted strips. The mountings are all suitable for the high pressure at which the engine is worked, and every part of both engine and boiler are fitted and finished in the highest style. Messrs. Robey & Co. also show a horizontal fixed engine fitted with Richardson and Rowland's trip gear. When steam engines are of large size, and work with steam of high pressure, the working of the slide valves becomes an appreciable part of the load upon the engine, and to obviate this various kinds of equilibrium valve gear have been introduced, the best known among them being the Corliss with rotating valves, and the Sulzer with Cornish double-beat valves, a variety of which is also known as the Proell gear. All these gears are manufactured by Robey & Co., and can be fitted to their engines when required, but their large experience with the different varieties has enabled them to discern the weak points in each kind, and as a result they have produced a trip expansion gear which is the simplest, most effective and most easily worked, and gives the most satisfactory results of any hitherto made. The cost of an engine fitted with this gear is necessarily greater than those with slide valve gear, but the extra outlay is compensated for by the lessened wear and tear and greater efficiency; this is the more noticeable in the larger sizes. The trip gear can be fitted to all sizes from 10 H.P. upwards, but is specially recommended above 30 H.P. nominal.

The Incandescent Lamp Case.—The report compiled by Professor Stokes is a very interesting addition to electrical literature. The duration of the lamps made by the plaintiffs and defendants respectively upon their reading of Edison's specification, discloses a fact which Mr. Justice Kay will doubtless deal with fully. Much as we would like to give an opinion on the main point which these experiments seem to prove, we must refrain from so doing until after the judgment, when probably it will then be quite unnecessary.

Transformer Litigation.—The case of Gaulard and Gibbs *v.* Ferranti, in which the question at issue is the infringement of secondary generator patents, has been before Mr. Justice Kekewich for the past two or three days. There is a strong array of legal and scientific talent engaged in the case, Sir William Thomson, Dr. Hopkinson, Prof. W. G. Adams, Prof. G. Forbes, and other well known scientific witnesses being retained on one side or the other. We shall devote more attention to this case next week.

Electric Traction in the States.—The Electric Car Company of America enjoys the privilege of having Mr. W. Wharton, jun., as its president. Mr. Wharton is well known and highly esteemed all over the States; he is one of the largest tramway contractors in America, and he is consequently looked upon as a reliable authority on all tramway matters. Within the last few years Mr. Wharton has turned his attention to electric traction, and we have on several occasions referred to successes attained under his directions. We learn now that this company is very busy in constructing electric cars, under Mr. Reckenzaun's patents, for tramlines in Philadelphia, Buffalo, St. Louis, and San Francisco, and it is expected that most of these will be in operation within the next three months. The cars, which have already run many thousands of miles in the City of Philadelphia on an experimental scale, have proved entirely successful, and have, therefore, led to orders from all parts of the country. This firm does not confine itself to storage battery cars only, but supplies also overhead and underground conductors; samples of each system can be seen in operation in the extensive works at Washington Avenue. The Electric Car Company makes it a rule never to allow a vehicle to leave the works until it has been thoroughly tested, and the utmost care is exercised in ascertaining the precise amount of energy consumed under varying conditions of load and road. The account which Mr. Reckenzaun gives this week of some of these tests is really admirable, and we would commend these useful and practical figures to those who doubt the practicability of electric traction, as well as to those who are in the habit of making statements based on mere assumption.

Technical Instruction.—The series of conferences on technical instruction, which have been held during the present session, is to be brought to a conclusion on Wednesday next, when the final conference will be held at the Technical College, Finsbury, at 8 p.m., under the presidency of Sir Albert K. Rollit, M.P. At the former conferences technical education was discussed in relation to the training of artizans in different trades. At this conference, which will be an open one, not restricted to any particular trade or group of trades, discussion will be invited upon the proposals for technical instruction now before Parliament.

Another Theatre Fire.—The Bordeaux Theatre known as the Bouffes Bordelais Theatre was entirely destroyed by fire on Tuesday morning. Happily no lives were lost.

Railway Accidents.—The necessity of a good earth connection, although well known in the case of telegraphy, is not a matter which it would be imagined could result in any bad consequences; nor, indeed, in the case of block-signalling instruments would it be thought that a defective earth could lead to any serious results. Contacts between the wires of block signalling and telegraphic apparatus are of frequent occurrence and only result in delays, the established practice of requiring the signals to be repeated and acknowledged preventing any important misunderstandings arising. In the case mentioned in our article on page 4, the contact caused by a bad earth led to a result which was probably never anticipated, and consequently not provided for, and seems to show that further invention is required.

Progress in Corea.—Steady progress is reported in the trade of Corea, the total net value of the imports and exports at the three open ports in 1887 being £729,000, as compared with £571,000 in 1886. A line of telegraph is to be made to join the capital with Fusan, taking in several large towns on the way. The poles for this line have been imported from Japan, and the other materials from Germany. The king's palace has been furnished with Edison's electric light, and this has been found better and more economical than candle and kerosene.

Burglars Caught.—Electric bells have their value in giving warning of the presence of burglars. It was owing to an electric bell and the resolute conduct of its possessor that James Dodsworth found himself one morning last week in the dock at Leeds. He and another man, who escaped, had entered the boot shop of Mr. Albert Brannan, and the vibration of an electric bell in a bedroom gave ample notice of the knavery in progress. Mr. Brannan showed himself a man of method. One brother ran for a policeman and a second stood on guard with him outside, armed with a poker. The prisoner was seized with terror lest he should be shot, but he was only knocked down and secured.

Lightning Photographs.—The Council of the Royal Meteorological Society has issued a circular requesting that photographs of lightning may be sent to them. In response to a similar appeal last year, about 60 photographs of lightning-flashes were received from various parts of Europe and America.

Pumping by Electricity.—The question of the water supply has for some time been exercising the minds of all classes in Poynton, a Cheshire village, and especially so during the recent dry weather. The attention of Lord Vernon has been called to the scarcity of water, and he is just adding a new supply, which will place the village in a much better position than it has ever before enjoyed. His lordship has sunk a well 84 feet in depth to the new red sandstone, about half-a-mile from the reservoir, and is arranging to pump the water and carry it by means of pipes to the reservoir. The arrangements for pumping are as follows;—A small engine has been placed at the Lady Pit, where the pumping operations of the collieries are carried on. This engine, worked by the boilers at the pit, drives a Gramme dynamo, which acts as a generator. An electric motor is fixed at the top of the well, and this motor drives, by means of belt gearing and cranks, two ordinary ram pumps having 3½-inch rams and 9-inch stroke fixed in the well. When ordinarily working, the speed of the dynamo and motor will be about 800 revolutions per minute, and the speed of the pumps about 40 strokes per minute. At this speed the quantity of water pumped into the reservoir will be at the rate of about 1,200 gallons per hour. The electric machinery has been erected by Messrs. Stanley and Davies, of Hyde.

Electrolysis by Alternating Currents.—With reference to the article by MM. G. Maneuvrier and J. Chappius, on the subject of electrolysis by alternating currents, the explanation of the phenomena observed does not appear to us to require much elaboration. The greater the surface over which the gas has to be generated the slower must be the rate at which the bubbles form, as the current density is obviously less over a large than over a small surface, and as the bubbles have not sufficient buoyancy to detach themselves from the surface to which they adhere until they reach a certain size, it must be obvious that unless the quantity of electricity from an alternation is sufficient to form bubbles of a definite size, the latter will simply inflate and collapse, as it were, without becoming detached.

Fond of Noise.—It is stated that on the down platform at Hook Station, near Odiham, can be seen a sparrow's nest in the box of the electric bell, which loudly rings for passing trains. The birds (there are several young ones in the nest) take little notice of the rattling of the bell or of the passing trains.

Burning of an Electrically-Lighted Mill.—A disastrous fire near Pesth has destroyed one of the largest steam flour mills in the world. The mill contained more than 1,000,000 bags of flour. The workmen were rescued with difficulty. The entire establishment was lighted by electricity, and the lights went out immediately after the fire broke out. Two firemen were killed, and several firemen and workmen were badly hurt.

Edinburgh and the Electric Light.—At the last meeting of the Edinburgh Town Council, in reply to Mr. Ritchie, the Convener of the Streets and Buildings Committee said that any concession the Town Council proposed to give the Anglo-American Brush Company was not in the nature of a monopoly, and would not prevent other electric light companies supplying light in the city.

Electric Launches at Henley.—Says the *Standard* in its account of the Henley Regatta: "So many strange craft are, from time to time, seen at Henley, that it is difficult to imagine anything fresh; but in addition to canoes of every known type, to row boats of every size and build, there is this year a novelty in the shape of the electric launch of Messrs. Immisch & Co. At present the only specimen afloat at Henley is the *Malden*, but another one, capable of carrying 70 persons, is in course of construction. How far the difficulties incidental to charging the accumulators just when wanted will be got over remains to be seen; but the convenience of a fast travelling boat with no smell of oil and no blacks from the funnel to soil the fairest of frocks is obvious."

Mill Lighting at Halifax.—Union Mill, belonging to the Sowerby Bridge Flour Society, Halifax, is to be lighted by electricity. The contract for 200 lights has just been made with Messrs. Blakey, Emmott & Co. The experiment has already been tried at the Society's works at Hebden Bridge, and the present extension is the result of the wonderful improvement effected there.

Halifax and the Electric Light.—Messrs. England and Foster, solicitors, have forwarded an application to the Halifax town Council from the Schmidt-Douglas Electric Lighting Company, making proposals with a view to lighting the principal portions of the town with electricity before the coming winter. The Mayor has promised to call a meeting of the Council, in committee, at an early opportunity to consider the matter.

Fatal Accident.—At Dochgarroch, near Inverness, on Friday last, a man named William Wilson, a telegraph lineman, belonging to Kirkwall, lost his life by falling from the top of a telegraph pole.

NEW COMPANY REGISTERED.

Westminster Electric Supply Company, Limited.—Capital £100,000 in £5 shares. Objects: To carry on at Westminster and elsewhere the business of an electric light and power supply company in all branches. Signatories (with 1 share each) *Joseph Browne Martin, 2, Victoria Mansions; *Hy. Kimber, M.P., York Street, Westminster; Sir J. R. Heron-Maxwell, Bart., Carlton Club; *R. W. Wallace, 2, Harcourt Buildings, Temple; J. W. Hiscox, 3, Victoria Street, S.W.; W. H. Baker, 74, Vincent Square, Westminster; W. A. Hunt, jun., 45, Parliament Street. Directors' qualification: 50 shares or £250 stock. Remuneration: £200 per annum to the chairman and £100 per annum to each director. The signatories denoted by an asterisk are the first directors. Registered 30th ult. by Linklater, Hackwood, Addison and Brown, 2, Bond Court, Walbrook.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Institute of Medical Electricity, Limited.—An agreement of 30th April, filed 13th ult., between Lieut.-Col. Nesbit Willoughby Wallace, of 3, Easton Villas, Southsea, and this company, provides for the purchase of the patent rights, premises, goodwill, and business of the Electrified Rooms Company, Limited. The purchase consideration is £175 and 1,925 fully paid shares of £1 each.

The statutory return of the institute, made up to the 21st ult., was filed on the 27th ult. The nominal capital is £20,000 in £1 shares. 3,300 shares are taken up, 1,887 being considered as fully paid. Upon 1,413 shares 10s. per share has been called; the calls paid being £655, and unpaid £51 10s. Registered office, 16, Clifford's Inn, Chancery Lane.

Schanschieff Electric Light and Power Company, Limited.—The statutory return of this company, made up to the 29th ult., was filed on the same day. The nominal capital is £200,000 in £5 shares. 20,000 shares have been taken up and the full amount has been called thereon. The calls paid amount to £64,791, and unpaid to £35,209. Registered office, 65, Basinghall Street.

Chelsea Electricity Supply Company, Limited.—The annual return of this company, made up to the 28th May, was filed on the 28th June. The nominal capital is £100,500, divided into 20,000 shares of £5 each, and 500 shares of £1 each. 164 shares of £5 have been allotted, and the full amount has been called and paid thereon.

House-to-House Electric Light Supply Company, Limited.—The statutory return of this company, made up to the 18th ult., was filed on the 2nd inst. The nominal capital is £350,000, divided into 69,900 ordinary and 100 founders' shares of £5 each. The shares taken up are 5,907 ordinary and 100 founders' shares. Upon 4,000 ordinary shares £1 10s. per share has been called, and the full amount upon 1,907 ordinary and 100 founders' shares. 900 ordinary and 100 founders' shares are considered as fully paid up. The calls received amount to £11,035. Registered office, 117, Bishopsgate Street.

Ashworth Brothers and Company, Limited (Electricians).—The registered office of this company is at the Union Ironworks, Franklin Street, Rochdale Road, Manchester.

"Electrician" Printing and Publishing Company, Limited.—The registered office of this company (filed 30th ult.) is No. 1, Salisbury Court, Fleet Street.

Parker's Electric Wire Company, Limited.—The registered office of this company (filed 29th ult.) is at Temple Chambers, Temple Avenue, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

United Telephone Company, Limited.

THE eighth annual general meeting of the United Telephone Company, Limited, was held at Cannon Street Hotel, E.C., on Tuesday, Mr. James Brand (the chairman of the company), presiding.

Mr. Thomas Blaikie, the Secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, you have all received a copy of the report, and have, no doubt, studied the accounts. I will not trouble you with going over these accounts just now, as I know that there is a gentleman, a friend of mine, in the room, who is going to make some enquiries as to the accounts by-and-by, and then I will endeavour by myself, or by some of my friends here, to answer him as well as I possibly can. Very likely you will have noticed that at the commencement of this present session our board, being desirous of giving effect to the recommendations of the Select Committee of 1885, lodged a Bill in Parliament asking for this company the powers which that committee said we ought to have, and giving a central authority the powers of inspection and control suggested by that committee. Well, the Postmaster-General was not disposed to aid us in passing this Bill. He suggested that the Local Government Board, perhaps next year, might be the proper persons to deal with it. We did not desire to have any conflict with the Government or the authorities, and therefore we withdrew the Bill for the present. We may have something more to say about this matter next year. Then, I should say a word or two on a very important subject indeed, and that is as to our relations with our subsidiary companies. I was very much surprised to read in the report of the South of England Company, held on June 29th, some remarks reported to have been made by the chairman of that company as to the relations of his company with the United Company. I feel sure that Mr. Bateson, the chairman of the South of England Company, would not willingly say anything but that which he believed to be true, and I can only suppose that he has forgotten the numerous interviews that we have had with him, and the proposals that we—the United Company—have made from time to time. The United Company have, through the General Post Office, run a wire to Tilbury, among other places, at their own expense. On April 20th, 1887, we wrote to the South of England Company offering to work this line at our own expense, and give the South of England Company half of any profit that was made, and to bear the whole loss, if any, ourselves; and I pledged myself to Mr. Bateson that if at the end of one year this manner of working this trunk proved unsatisfactory to him or his company, the whole matter should be revised and settled in a way that should be satisfactory to his company. Now, again, as to the Brighton wire. The General Post Office ran this wire also for the United Telephone Company. For two years, 1884 and 1885, we paid £446 10s. per annum ourselves rent to the Post Office. After that I arranged with the chairman of the South of England Company that his company should pay one-half of the rent of the Brighton wire for 1886, and for all time after; but that the United Company would at their own cost fit up the necessary apparatus in the switch-room at Brighton. Since then the South of England Company have worked the Brighton trunk wire without let or hindrance from the United Company. The United Company have paid the rent of the wire for 1887 and 1888 to the General Post Office; but we have not yet received any payment on account of these two years from the South of England Company. On June 29th the South of England Company wrote, agreeing in a great measure to certain proposals I had made in the letter I have mentioned on April 20th, 1887, and yet at the meeting that was held on Friday last—that is, the same day as that on which the letter was written—the chairman of the South of England Company is reported to have said, in reply to Mr. Billett's question—(who said: "Surely it could be no intention of the United to stifle its own children")—"We have proposed terms and cannot get them"—that is, the United Company—"to second them at all. They refuse to enter on the subject at all. Since I have been in the chair I have constantly urged this matter on the United Company, but have got no further to-day." A good deal of the property of the United Company, as you know, consists in its shares in the subsidiary companies, and we should be fools, indeed, if we tried to stifle our own children. It is not true that the United Company puts obstacles in the way of trunk wires. It is our own interest to push trunk wires with all our might. We are doing it now, and it will be one of our chief operations in the future. The National Company is as anxious in this direction as we are to join its different centres on to our system. On January 3rd this year the United and the National Companies made arrangements mutually satisfactory for the erection and working of a trunk wire to Birmingham. I think I may say that the difficulties of the way-leaves are practically overcome. We have been met in a liberal spirit by the landowners with whose property we interfere, and we hope that within a month we may be able to commence the construction of the line. This line will provide nearly half the distance required to connect Manchester and Liverpool with London, and also enable Nottingham, Leicester, Derby, Sheffield, and other Midland towns to speak to London, as also the Northern district towns of Newcastle, Sunderland, &c. The same desire for inter-communication exists between the Western Counties Company and ourselves, and friendly negotiations are in progress for connecting London and Bristol, and the Western Counties have got as far as Bath. They have considered it best, however, before tackling with us the heavy outlay for the trunk wire to London, to connect their headquarters at Bristol with Newport, Cardiff, Swansea, &c., and the coal and iron fields of South Wales. You are aware that our agreements with our subsidiary companies prevent us running trunk lines from London to any town beyond 12 miles, and working without the consent of the subsidiary companies. They all know, however, that we are willing to join hands with them. I think I have said enough on this matter to show you how groundless are the curious statements that are constantly being made as to the dog-in-the-manger policy of the United Company It is hardly possible for the shareholders to realise the difficulties that we meet with and have to overcome; and I wish the shareholders would lend us their aid to a greater extent than they do. It is surprising how few of the shareholders are subscribers to our lines. I do not think that 10 per cent. of our shareholders subscribe to our exchanges. However, we do the best we can, and during this year we have increased our mileage of wire from 7.500 to 8,700 miles. There are at present free call-rooms for the use of subscribers existing at Oxford Court, Chancery Lane, the Law Courts, the House of Commons, Regent Street and Edgware Road, and arrangements have been made, in deference to the wishes expressed by some of the shareholders and as a matter of experiment, for establishing paying call-rooms at Kilburn, Balham, Limehouse, Earl's Court, Denmark Hill, Holloway, Brixton, Greenwich, Notting Hill, Croydon, Richmond and Brentford. I must tell you that these paying call-rooms have not been so much pushed by the United Telephone Company as perhaps by some of the other companies further north and west. Our opinion is that these call-rooms in London, as a matter of revenue, will not be very successful. In the North they have proved a good source of revenue, but then that is because of the trunk lines existing between town and town, and the public who are not subscribers take advantage of the call-rooms to communicate from town town to town, and are willing to pay 3d. or 6d. or 1s., or whatever it is. However, we think it is a good thing to try the experiment, and if it does not pay us directly by revenue we think it will pay us by educating the people more and more in the inestimable blessings of the telephone. We have put up during the year new iron derricks, at great expense of course, to replace those derricks that were destroyed in the snow storm. We have opened a new exchange at Smithfield with a largely increased capacity, and the lines have been transferred from the old exchange to the new. With the view of centralising the work of switching, three minor exchanges have been closed; these are Leadenhall Street, Stratford and Shadwell. The exchanges having been transferred to the larger exchanges, a new multiple switchboard has been erected in the new exchange at Smithfield, and preparations are well advanced for erecting multiple switchboards at East India Avenue, Westminster, and Chancery Lane. We have opened and got in very good order now a new trunk line to Croydon on our own poles, free from the induction of railway poles and other electrical wires, and it is working very well. It has only been opened about a month and we hope it will be a source of good profit to us. Then I come to a question that has no doubt occupied your minds a good deal, and that is the question of amalgamation. All sides are agreed that an amalgamation would certainly be desirable in the interest of all the companies, provided it can be settled in a manner fair, not only in view of the present state of our company, but also taking into account to some extent their future prospects. This latter consideration will involve questions of considerable difficulty, and it will be necessary to ascertain how far the accounts of the several companies have been made up on the same basis as regards allowances for depreciation of wires, plant, &c., and also as regards the allocation of expenditure between revenue and capital. To enable us to have a basis for discussion on these points the accounts of the various companies are now in the hands of Mr. Griffiths, the eminent accountant, and when his report comes in—which it will certainly take some weeks to prepare—we shall be able to meet the directors of the other companies and see how far their views accord with ours as to the proportions to be allowed to the various companies. Of course, before making any arrangements for amalgamation it would be necessary to obtain the consent of the Postmaster-General to the various licenses being transferred to the new company. Subject to this being obtained I am personally very much impressed with the advantages of carrying out this scheme, and my colleagues on the board heartily concur in my views; and if all sides are animated with a desire to settle the questions that may arise in a fair and liberal spirit I can see no reason why the thing should not go through. It would be idle, however, to shut our eyes to the fact that questions may arise on which different opinions may legitimately be held, and of course they may be more or less difficult to solve. The question as to the value to be attached to undeveloped business is an apt illustration of what I mean. Such questions, I hope, we shall always meet in an equitable spirit; but, of course, we have your interests to protect just as much as the directors of the other companies have the interests of their shareholders to look after. I know very well that this matter should be settled promptly, for until it is settled it retards the development of the company's business in new lines and connections in the direction of which I have already spoken. You will have seen from the accounts laid before you that during last year we have expended nearly £29,000 on this account, but this has been solely within the Metropolitan area. Well, then, as to law during the year, Mr. Winterbottom has sent me this report, which I will read to you. He says: "Since the decision of the Court of Appeal in favour of the Edison patent, in the action against Messrs. Bassano and Slater, of Derby, there has been no serious attack upon the company's patents, and the directors were in hopes that the many ingenious attempts to get outside the patents were at an end. However, at the beginning of the present year Mr. Campbell Swinton, a Scotch gentleman, brought out an instrument, and formed a small company to manufacture and sell it, and as the company was beginning to do business on a somewhat extensive scale, it became necessary to take action. The directors are glad to say that an interim injunction was promptly obtained, which has, for the present, put an end to further sales, but the defendants appear inclined to fight the whole question over again. As the question of the validity of the company's patents has already been decided by the Court of Appeal, and the directors had the best possible advice (that of the present Attorney-General and other well-known counsel) that the instruments are infringements, they are in no way anxious about the result. At the same time it is much to be regretted that the law allows limited companies without any uncalled capital to put a patentee to all this expense after the question has already been litigated and decided." I think I have said enough for the present. I now have to move: "That the report and accounts be received and adopted, and that a dividend for the half-year ending the 30th April last of 10s. per fully-paid share and of 5s. on the new shares, less income tax, be paid, making a total dividend for the year of 15 per cent. on the paid-up capital of the company."

Mr. James Staats Forbes seconded the motion.

Mr. Sichel referred to the £15,000 in the balance sheet for snow expenses last year, which seemed to double the amount which the chairman at the meeting last year stated was the probable cost of the loss involved. He supposed there was some good reason why this was done, but the £15,000 charged this half year was equal to 3 per cent. on the capital of the company, and if that had not appeared in the accounts, they would have had a bigger reserve, or they might have been favoured with a bigger cheque for dividends. The chairman had remarked that he was anxious that the public at large should value the benefit of the services of the company, and have some understanding of the value of it. With diffidence, he ventured to think that the public at large were fully alive to the value of the telephone, and that the place where there was a want of sufficient knowledge of the value of the telephone was on the other side of the table. He was told that the call offices of the Metropolitan area were a source of loss of revenue, as they led to a loss in regular subscribers; but, as an individual member of the public, and as one coming in contact with a great many who used the telephone, he thought an enormous increase of call offices would be a boon, and ought to be a source of great increase of revenue to the company; and he would couple with that idea the system of issuing yearly tickets to subscribers at a price of four or five guineas per annum, entitling the holders to employ any call office within the area of the metropolitan district, when he wished. If the board would employ canvassers to increase their subscribers they would find that scarcely a large retail shop in London would not find it a necessity, almost, to take up the idea. Members of clubs would find the system the greatest convenience, and he believed at the Stock Exchange they would find 1,000 or 1,500 members would like to have their residences in connection with the centre of their city occupation. They ought to get 10,000 subscribers who would be pleased to have a telephone ticket in their pockets. He did not claim originality of the idea, for he had seen it employed in Paris. He was satisfied that the business was capable of immense extension. It was particularly necessary that they should increase the number of their subscribers in view of the death of their patents three years hence. At the end of that time it would be the connection that would be valuable, and they should be in a better position having regard to the ultimate fate of the company in being bought up by the Post Office.

Mr. Begg said his friend the chairman had made an allusion to him in his opening remarks, and he wished to ask some questions. In order to make his criticisms definite, he had written the questions down, and the chairman knew what questions he proposed to ask. He suggested that the chairman now answer those questions, and he could follow with any criticism he might wish to make.

The Chairman said he would read the questions and answer them as far as he could. Mr. Begg had called at his office and the telephone office over and over again, and sat with him by the hour, but he had done all he could to make his enquiries in a good spirit, and he was much obliged to him. His first question related to the reserve account—how was it made up? Well, it was made up partly of sums written directly off profit for the year; partly in sums put into account for depreciation; partly in profits derived by the sale of instruments to the Admiralty or to certain railways; and partly from the premiums obtained on the issue of new shares.

Mr. Begg: How is it invested?

The Chairman: As I said last year it is in the air; it is in the poles, the derricks, the wires, and generally in our business. Continuing, the chairman said he had alluded to the possibility of the board having to call the shareholders together to consider the question of increasing the capital for trunk wires, for great distances, and he said they would not be able to do those things as they had done hitherto, by using the money they had written off profit for reserve and depreciation, and so on. Mr. Begg next asked as to directors' fees—"are any special fees or allowances drawn by any of the directors beyond those shown in the accounts?" Well, the only special fee that was drawn by any director was that by the managing director, who did not share in the fees of the other directors, but was paid under a separate arrangement, which was that they paid him £1,000 per annum, and 2½ per cent. on the divisable profit, after 10 per cent. had been paid to the shareholders; in addition, he was paid about £400 for travelling expenses and expenses in London. This year the amount paid him altogether had been about £3,000.

Sir Julian Goldsmid: It is an illegal payment.

Mr. Forbes said it was in accordance with the articles. He read a clause to the effect that the directors had power to appoint a managing director from among their number on such terms as they might decide.

Mr. Sichel: Does the amount paid to the directors and the managing director come to £15,000 a year?

The Chairman: It is nearly £10,000. The Chairman continued, Mr. Begg said the royalties did not appear to have been accurately adjusted, and he asked were any of the companies in arrear, or were accounts in dispute, like that of the South of England Company. As he understood it, there was no discrepancy; it was the way of putting down the royalties. As regarded the other matter, there were sums remaining to be paid by the affiliated companies, and these appeared in the balance sheet, among sundry debtors. In one case a considerable amount was involved, but, inasmuch as it was precisely similar to a case concerning the Lancashire and Cheshire Company, which was decided in their favour by the courts, that he did not anticipate any difficulty in settling the matter with other companies on the same basis. Mr. Begg next referred to the charges and working of the metropolitan area, and said they showed large increases for salaries, wages, &c.—say £7,000—while rentals increased (cash) £2,431, or per rent roll, £6,851 only. Result—less net revenue by £3,302 in cash this year. Why, he asked, was there such an increase? He (the Chairman) had referred this question to Mr. Welton, whose explanation was that these charges were not merely for the expenses of collection of dividends and royalties, and he considered them very moderate indeed. The accounts were made up on the basis that the two revenue accounts belonged to two separate companies. The working charges were made to look worse this year because they compared with the year 1886; last year the working expenses were less than usual, because during a good part of the time they were rebuilding and maintaining, and in the rebuilding, of course, the maintaining was included, and put into the expenses of the good old snowstorm. They were rebuilding, not maintaining, so the revenue paid for it. Some of the expenses also arose from opening outlying centres. With regard to capital expenditure, Mr. Begg said, "This seems to bring a much reduced increase of revenue—why?" He asked Mr. Welton to explain this.

Mr. Welton said there were 749 new exchange lines, costing £12,760, but the number cancelled was 422, the loss of revenue on that being £9,647, so that the net benefit was £4,113. In the same way they provided 287 fresh exchanges, costing £5,712; but the number cancelled was 138, the rental on which would be £2,975, the net benefit being £2,737 in the year, and the total increase on revenue being £6,851. That would be due to many customers having withdrawn or become bankrupt.

Mr. Begg held that the management of the company on the one hand was extravagant, and in the second place inefficient. With regard to extravagance, the reserve fund, Mr. Brand had explained, consisted principally of two items: there were in it the premiums on the new capital which the company issued and other sums carried to it for depreciation. He only found the record of one such sum, and that was in 1884; since then the reserve account had been added to without any particulars being given. In 1884 the item placed to reserve was called reserve against depreciation. Depreciation meant waste, and he said that any sum which was depreciation being carried to the account called reserve was misleading. Then as to premiums on new shares, that was a fair subject for the reserve fund in a sense, but it was a capital reserve, not revenue; it was not a reserve fund that could be used for the ordinary purposes of a reserve. With regard to the directors' fees, he would leave them to speak for themselves. With regard to the royalties, the chairman said the accounts were adjusted to date; that accounted for something in the figures which struck him as rather peculiar. Speaking from memory, the revenue brought in respect of royalties from the sub-companies during the past year represented an increase of £5,600. The royalty might be taken roundly at 10 per cent., therefore that represented £50,000 additional subscription in the sub-companies; but he found in looking at the revenue of the sub-companies for last year, the total revenue of the companies other than this was £200,000. Therefore these companies must have increased their revenues by £50,000 during the past year. Either they had or they had not. If they had, so much the worse for this company, because they had only got an increase of £2,600 in their accounts other than royalties; while if they had not, the sums in respect of royalties had been brought unduly into this year's account. The directors must settle which was the correct reading of these figures. The question of general charges was a difficult one to go into. They might go into the figures all day and not come to a satisfactory conclusion. It seemed that the snowstorm was made to pay for all. With regard to general revenue, it had been said that this company consisted of two companies—the Telephone Exchange and the management of the subsidiary companies. What did the other part of the company's business consist of? Collecting royalties, distributing dividends, and taking actions. He did not know that the actions were a mistake, because, of course, they must defend their patents; but he saw no justification of an expenditure of £6,000 or £8,000 in salaries, &c. After quoting the comparative statement in the accounts to show that the expenditure of capital in the latter period of the company's existence was not followed by the increase of revenue that ought to result, Mr. Begg said the explanation was probably that a great number of lines were given up. But this was the strongest condemnation of the company's management. He knew a good deal of telephones in the provinces, having worked amongst them very hard for the last 8 or 10 years, and he knew that anything like the giving up of a line was an exceedingly rare thing. With regard to the general management of the company, the directors of this company seemed to be entirely ignorant of what was going on round about them. Throughout the provinces call offices had been in existence many years, and he was satisfied that they had been and were now a large advantage to the companies using them, and were successful. The call offices he meant were for the use of the public, not merely for subscribers, as in the case of this company. He laid it down as a general proposition that there was not a telephonic exchange that was not open from one year's end to the other continuously, except London, and London was the place of places where such a service was required on Sundays. There was no delivery of letters on that day, and they could scarcely send a telegram on Sunday. The cost of making the system continuous would be practically nothing—not more than £500 or £1,000 a year to establish it at once. The only other question he would trouble them with was the question of trunk wires. They had trunk lines everywhere but in London. Every town of magnitude had telephonic communication except London, and here in London there was not a single trunk wire line, except Brighton. The chairman said he was willing to join hands with the sub-companies about the trunk scheme; but willing to join hands was not the attitude of the board of a telephone company. The board should insist, and if others would not go ahead in the matter compel them to. He did not wish to make a hostile motion, but should like to test the feeling of the meeting, and would formally move that the accounts be not passed, and that a committee be appointed to investigate the affairs of the company and report to the shareholders.

Sir Julian Goldsmid said at the last meeting he made complaints which the chairman said would be considered. They had been considered by being ignored. He pointed out last year that there was no company with a capital of half a million whose directors were paid such excessive sums. He accused the chairman of concealing the fact at the last meeting that the managing director was paid a large sum over and above the directors' fees.

The Chairman denied this, and said he stated definitely how the matter stood.

Sir Julian Goldsmid further stated that after the last meeting one of the directors, Mr. Quilter, said he quite agreed with him that the directors were paid too much. He urged that although the fees were provided for in the articles, the articles could be altered. Of the profits made by the company, the directors had had a third. It was a disagreeable thing to make an attack on men of high standing; but he felt that in a company of the sort they had no example of directors being so extravagantly paid. He thought, therefore, that the articles should be altered so that there should some revision of the accounts. He seconded Mr. Begg's amendment.

Sir Edwin Galsworthy was surprised at the accusation of the last speaker, that the board kept back the fact that the managing director was paid a large sum for his services. That was an unfair charge. He held that the charges of extravagance and inefficiency had not been proved, and as to the directors' fees, he urged that if they wanted to alter them, let them go the right way to work, and sign a requisition for a special meeting to alter the articles of association.

After some further discussion,

The Chairman said he would ask his friend Mr. Forbes to answer some of the questions put. He commented on the unexpected violence of the attack on the directors, when he believed they were giving the shareholders a good account and declaring a good dividend. With regard to the fees, the directors felt they had made a bargain with the shareholders, and they did not see that under the circumstances of the case they should be called upon to give up the profits of the bargain. It was made some years ago when the invention was first bought, and the directors had spent a good deal of time and money in developing the thing, which was then utterly unknown in this country. The directors had kept to the bargain; they had not sought to increase their remuneration, though in some ways he thought they might have done so, and they certainly did not expect it broken on the other side. If the amalgamation took place there would be new articles of association, and the shareholders could reconsider the question then if they chose.

After reference to the report of the last meeting, Sir Julian Goldsmid explained that he left the meeting before the reference to the matter of the managing director's salary was made.

The Chairman said with regard to the snowstorm the loss was estimated at £15,000, and £5,000 were put aside, which they had expended to within £160. Then, the meaning of the further £15,000 was this: while they were mending their wires they avoided as much as possible calling on subscribers to pay their subscriptions, which, as a rule, were paid beforehand. When they got their system in order they began to collect the money, when they found their large customers demanded a reduction for the three months' delay in the system, and the directors had to make the best arrangement they could, and allowed about one and a half or two months' subscriptions to people instead of giving them back any money; they gave a 14 months' receipt for 12 months' use.

Mr. Forbes made a lengthy and somewhat humorous speech, in answer mainly to the remarks of Sir Julian Goldsmid, whose assertion that the proportional payment to Mr. Morgan was illegal, he controverted. The contract with the directors was a legal and binding and moral contract, which they were bound to carry out. £1,500 a year was divided between seven gentlemen; and such gentlemen! They got for five years, during all the labour, anxiety, and discouragement and difficulty of making this company—and it was they who made it—£210 a year apiece on the average. He would ask which of them, having the capacity and knowledge, would do this sort of work for £200 a year? By dint of their brains and knowlege they had got the shareholders' dividend up beyond the 10 per cent., and had become partners; they were to have 20 per cent. for all the money they made after payment of 10 per cent. He would defend that bargain against all the world. Mr. Begg's criticisms would have been admirably apposite if he had known anything about the business. Mr. Begg had remarked on the manner in which the directors had neglected the company's interests in not developing call offices. If Mr. Begg had the figures before him that he had got, and the knowledge he possessed, he would not have been so very much surprised. He would say, "What is the cream of this business?" And as long as he could skim cream he did not want to skim milk. The cream of this business was the exchange. The exchange returns were the largest income of these companies, in the relation of all to nothing, and these call businesses were a mere bagatelle. There was no comparison of any city or place in the world with London. Look at the mere question of way-leaves! Everything this company had to do was on sufferance. Their services were multiplied, because they could not get the shortest cuts. He hoped Mr. Begg was not going to press for a committee to inquire into their business. He, for one, was not going to submit to any such committee. Either the directors knew their business and were worthy of confidence or they were not. When the shareholders thought they were not, let them turn them out and let in Mr. Begg, or anyone else they liked. He knew of no form of censure so unjust and so insidious as this committee of inquiry. He, for one, was not going to work for £200 a year; he could carry his brains to a more successful market. The directors knew the defect of their system; they knew its difficulties. The shareholders knew its defects, but did not know its difficulties. The future would require all the brains and knowledge that the company had got in their present directors, and it would be no favour to have paid them their fees if, as the result of their exertions, they succeeded in carrying the company on up to the time when it was taken over by the Government.

Mr. Begg said Mr. Forbes had made a statement to the effect that he was ignorant of the subject. He would ask his friend, Mr. Brand, to state whether he did not know he had been 10 years actively engaged on telephone work as the director of a telephone company.

The Chairman said he told his colleagues that Mr. Begg was a fair criticiser, and had had a good deal of experience. Mr. Forbes did not mean he was ignorant of telephone work, but of the many difficulties this company had to combat, and he said so too.

After some further debate Mr. Begg offered to withdraw his amendment, but the Chairman put it to the meeting, when it received but a small amount of support.

The original motion was then agreed to.

Mr. John W. Batten and Mr. Frederick R. Leyland, the retiring directors, were re-elected, as were also the auditors.

Sir E. Galsworthy proposed, and Mr. Begg seconded, a vote of thanks to the chairman, which was carried, the proceedings thereupon terminating.

South of England Telephone Company, Limited.

THE fifth ordinary general meeting of the South of England Telephone Company, Limited, was held on Friday, the 29th ult., at Winchester House, Old Broad Street, E.C., Mr. D. Owen Bateson (chairman of the company) presiding.

Mr. Fred L. Robinson, the Secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, we are pleased again to meet you, and to give you an account of our proceedings during the past year. The report and figures, which we have sent you, show our progress. We cannot pretend that our district is one that is capable of any sensational development. Still, I think we may lay claim to endeavouring to make the best of what has fallen to the lot of our company. You will note that our exchange lines have increased from 1,130 in 1887 to 1,521 in 1888; and private lines from 348 in 1887 to 386 in 1888. In the latter item the new lines have been many more than are indicated by those figures, but they have been counterbalanced by an unusual number of withdrawals. I apprehend this is occasioned by some of our subscribers having been induced by apparent cheapness to try some of the new-fangled instruments which are so industriously advertised nowadays. I do not think there will be a continuance of these withdrawals, as there is no doubt but that our instruments are the best; indeed, we have already had some subscribers, after buying the new ones, discard them and return to us, and they have assured us that the old ones are the most reliable and decidedly the best. As regards our gross rentals, they stand at £19,325, against £15,190 in 1887, showing an increase of £4,135; and, after deducting the amount carried forward to this year for unexpired terms and the royalties paid the parent company and the Post Office, we show a gross profit of £9,852. As the business increases the manufacturing and working expenses must naturally increase too. This year we have expended on these accounts £5,099, against £4,198 last year. Thus there has been an increase of £901, which, considering the additional extent of business done, is not an undue sum. In the accounts last year there was a debit of £1,365 carried to revenue on account of the damage done by the snowstorm of December, 1886. Happily this year we have met with no such disaster, and we trust for similar immunity in the future. We have taken every pains to guard against it, and some of our extra expenditure is due to charges for strengthening our system where we have found it necessary. As regards our capital, it will be seen that all the £20,000 6 per cent. preference shares are now issued; the 3,567 remaining according to our last report have been all disposed of at par, namely, £2 each, completing the extra issue with this since paid. It will be needful ere long to call another 10s. Your directors, however, will delay it as long as possible, knowing that the 6 per cent. interest will be an additional charge on the resources of the company. It will be noted that we have spent £16,457 on capital account this year, against £16,077 last year. You must be aware that in a new company such as ours, almost the entire expenditure is in construction work, and comparatively little on maintenance. The charge of running trunk lines comes very heavy on us, and hence a great part of this large sum. This year we have completed the Brighton, Shoreham, and Worthing lines, as also Brighton and Lewes. We are now engaged between Lewes and Eastbourne, as well as between Canterbury and Dover. These two lines we hope to complete within a month from this time. Our next trunks will be between Canterbury and Ramsgate, Deal and Ashford. For these lines we are busy canvassing for way-leaves. These are generally accorded us without much difficulty by both landowners and road authorities, and I beg to tender our thanks for their consideration in this regard. Now and then undue difficulties have been placed in our way, which we got over as best we could, and we have occasionally been obliged to vary our routes, often to our material cost. One line between Margate and Westgate we have been obliged to abandon altogether, consequent on the obstructive policy of the representatives of a charitable institution, much to our annoyance and the great inconvenience of our subscribers. I am happy to think this is quite an exceptional case, and an example not likely to be followed elsewhere. Our various exchanges are doing fairly well. Brighton runs far ahead of all the others, thanks in some measure to the efforts of our energetic and capable manager there. Our subscribers, exchange and private, have increased from 1,478 in 1887 to 1,907 in 1888, and we have no fear that they will stop at this figure. The trunk lines between Brighton and Worthing and also to Lewes and Eastbourne will doubtless much assist the development of this exchange. Our more business centres are not so active; however, Reading, Northampton, Norwich and Ipswich progress fairly. We have lately made a diligent canvass of all these towns and their environs, which we think will increase the number of our subscribers eventually. Cambridge continues to do well, and at last Oxford seems to be awakening to the advantages of our system. We have taken great pains to bring ourselves prominently before the authorities and tradespeople in this town. We are now engaged in developing new exchanges in Tunbridge Wells and Tunbridge, and Guildford will follow in due course. It would appear as though this would be a paying business, if we are not hampered by way-leave difficulties. The exchange in Canterbury promises well. We are making this a centre from which various lines are to radiate—namely, to Dover and Folkestone in the first place, and this portion of the scheme is nearly complete. Subsequently lines to Ramsgate and Margate will be run; also Deal, Sandwich, Ashford, and probably Faversham. If we carry out this plan each place on the radius will be able to speak to our subscribers at all the other towns on the radius. We think the scheme will tend much to develop our system in this district, and be a great convenience to our supporters. Westgate will necessarily be excluded from partaking of the advantages of the scheme for the reason I have before stated. I may say, however, that we are quite prepared to reconsider our determination of abandonment if the circumstances are so far altered as to enable us to run our lines. Our instruments continue to give every satisfaction to our subscribers, and we have very few complaints of bad service. These few are almost invariably occasioned by accidental contacts of the wires, and are set right with as little delay as possible. In many of our districts we have established fee-call offices, worked by automatic call boxes, by means of which anyone, whether a subscriber or not, on payment of 3d. for local or 6d. for trunk communication, can call up subscribers on the exchange and have three minutes' conversation. Up to the present we have not derived much revenue from this source, but we shall continue it, as we can see what an immense convenience it is to our subscribers and others, and it tends to bring our system before the public to popularise it. We expect when it becomes better known what the advantages of this scheme are, that we shall derive some profit from our outlay, which has been considerable. Now, as regards a dividend, it will be seen from the net revenue account that we have had £4,964 1s. 2d. to dispose of. Out of this we have already paid £1,849 in two half yearly dividends on the preference shares, leaving us with £3,115 0s. 8d. Our auditors have strongly advised us to commence a reserve, so we have decided to place £500 to such a fund. I must say that I hardly see the force of the auditors' argument as to this, it appearing to my mind somewhat of a farce endeavouring to secure a capital of £240,000 by anything we can possibly lay aside out of our limited income. It has, however, this good feature—that in case of any disaster, such as the snowstorm, we shall have something to fall back upon, without jeopardising our dividend. I am not disposed to accumulate this fund beyond the need in this direction, but this is for your consideration in the future. With the balance, £2,615 1s. 8d., we propose to pay a dividend of half per cent., amounting to £1,500 in the aggregate, carrying forward £1,115 0s. 8d., which is much the same as last year, viz., £1,058 9s. And now, gentlemen, I beg to propose that the reports and accounts for the year ending April 30th, 1888, now presented, be adopted and passed.

Mr. Alexander McGregor seconded the motion.

Mr. Billett: Has there not been some suggestion for these outlying lines to be connected with London?

The Chairman: We are not an independent company so far as that is concerned—one-half will have to be run in the United Company's district. We have urged this matter on them repeatedly, but we get no further. With regard to Brighton, it is a joint line between the United Company and ourselves; under the old management we pay one-half, and derive no immediate advantage from it. It was an experimental line.

Mr. Stewart asked if it was not in contemplation to consolidate all the telephone companies.

The Chairman said something had been mooted with respect to that, and there had been a meeting of the different subsidiary companies and the United. A sub-committee had been formed to investigate on what terms it could be done, but it had gone no further than that—it was only, as it were, in the air.

Mr. Billett raised the question of the terms on which the company stood with the parent company, especially in regard to the Brighton extension, and said surely it could be no intention of the United to stifle its own children.

The Chairman: Surely it ought not, but certainly it seems to be. We have proposed terms, and cannot get them to second them at all, or suggest any alternative terms. They refuse to enter on the subject at all. Since I have been in the chair I have constantly urged this matter on the United Company, but have got no further to-day. I hope shareholders will urge it upon them at the meeting which takes place next week.

A Shareholder asked if steps had been taken to obtain a quotation on the Stock Exchange, and if there were any chance of a settlement.

The Chairman said the Stock Exchange required certain alterations in their articles of association, but they were mere verbal matters. To make the alterations a special meeting would have to be called, and the directors contemplated doing that shortly if it were the wish of the meeting.

Mr. Stewart remarked that the United Company were very large shareholders in this company, and in their own interest should do everything in their power to further the extension that the company desired.

The resolution was then put and carried unanimously.

The Chairman moved: "That a dividend at the rate of ½ per cent. per annum be now declared, free of income tax, payable on July 2nd."

Mr. McGregor seconded the motion, which was carried.

Mr. Marshall proposed, Mr. Billett seconded, and it was carried: "That the sum of £200 be paid to the directors for their services for the 12 months ending April 31st, 1888."

Mr. T. F. Campbell, the retiring director, and Mr. J. Weise, the auditor, were re-elected, whereupon the proceedings closed with a vote of thanks to the chairman.

United River Plate Telephone Company, Limited.

THE report of the directors states that the result of the company's operations during the 16 months ended March 31st last, after paying all working expenses abroad, debenture interest, and London charges, and after writing off the whole of the preliminary expenses in London and Buenos Ayres connected with the formation of the company, amounting to £4,139 6s. 8d., is a profit of £34,942 1s. 6d., from which has to be deducted the sum of £10,775 19s. for loss on exchange, leaving a net profit of £24,166 2s. 6d., out of which an interim dividend of 2½ per cent., or £6,250, was paid in October last, the actual available balance being thereby reduced to £17,916 2s. 6d.

Out of this balance the directors recommend that a further dividend of 4½ per cent., being 4s. 6d. per share, free of income tax, be now paid, which absorbs £11,250; that £5,000 be placed to a depreciation and renewal fund; and that the balance of £1,666 2s. 6d. be carried forward to the credit of profit and loss account for the current year.

The shareholders will observe that the capital expenditure during the 16 months amounted to £56,415 3s. 7d., which includes the cost of the business in Rosario and the establishment of the exchange at La Plata, of which the directors informed the shareholders in their circular of 3rd October last, and also the purchase of an exchange at Corrientes, while the expenditure at Buenos Ayres is represented by the important and costly erection of the multiple switch board, and the improvements of the general system there. In order to further develop the company's business, the directors have recently made a provisional agreement for the purchase of a rival exchange business at Rosario, the possession of which, in conjunction with the business previously obtained, will, they believe, constitute a valuable addition to the company's property, as those who know the increasing importance of Rosario will readily appreciate.

The rapid extension of the company has made it necessary for the directors to be in a position to further consolidate and render thoroughly efficient the various points of the company's system, and so ensure larger working results. With that view the directors now propose, acting under the powers conferred on them by the articles of association, to increase the capital of the company by £25,000, being the equivalent of 5,000 fully paid shares of £5 each, which shares they will offer at par to the shareholders now on the register *pro râta*. These shares will rank for dividend as from the 1st April last, and, with the warrants for the dividend now recommended, a circular and form of application will be forwarded to each shareholder.

Notwithstanding considerable difficulties during the period under review, many of which were inseparable from the inauguration of an amalgamated business, the directors have every reason to be satisfied with the progress made, and believe that the business of the company will now steadily develop and increase.

Under the articles of association Mr. J. Irving Courtenay, deputy-chairman of the company, and Mr. R. E. Bateman retire by rotation at this meeting. Mr. Courtenay, being eligible, offers himself for re-election; Mr. Bateman, owing to pressure of other engagements, does not seek re-election, and the directors propose the appointment, to the vacancy thus occasioned, of Mr. John Coghlan, who since January last has given the board the benefit of his advice and of his experience in the River Plate, and whose appointment the directors therefore recommend the shareholders to confirm as from that date.

The London Platino-Brazilian Telegraph Company, Limited.

A GENERAL meeting was held on Thursday, the 28th ult., at Winchester House, Old Broad Street, Captain Francis Pavy in the chair, for the purpose of electing new directors.

The Chairman stated that the agreements between the company and the Western and Brazilian Telegraph Company had been carried into effect, and out of 38,348 shares forming the Platino capital, 33,515 had been exchanged for Western and Brazilian shares, or 4,000 shares beyond the three-fourths requisite to give effect to the agreements. The agreements had been duly registered and lodged at Somerset House, so that matters were now in order and the exchange virtually completed. In these circumstances, having carried over the agreements, it was only left, according to the arrangements, for the present directors to resign and for others to be appointed. He concluded by moving a resolution accepting the resignations of Sir John Pender, Captain F. Pavy, and Mr. John Hollocombe, and appointing Lord R. Howe Browne, Major A. Wood, and Messrs. W. S. Andrews, C. W. Earle, D. W. Goodsall, and H. Weaver directors of the company.

Mr. J. Hollocombe seconded the motion, which was carried unanimously.

Telegraph Construction and Maintenance Company, Limited.—The directors have decided to pay an interim dividend of 12s. per share on the 17th inst.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of June was 4,114, estimated to produce £3,000, against 3,613 messages, producing £2,929 in the corresponding month of last year. The receipts for the month of March, estimated at £3,800, realised £3,835.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th June are £2,553, as compared with £3,052 in the corresponding period of 1887. The March receipts, estimated at £7,086, realised £7,051.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending June 29th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,278.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for the month of June, 1888, amounted to £41,764, compared with £35,138 in the corresponding period of 1887.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of June were £1,690, against £1,561 in the corresponding period of last year.

The Eastern Telegraph Company, Limited. The receipts for June, 1888, amounted to £48 066, compared with £45,426 in the corresponding month last year.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for the week ending June 29th amounted to £3,941.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending June 30th are £5,225.

NEW PATENTS—1888.

8751. "An improvement in the Wheatstone automatic system of telegraphic transmission by which it is adapted for use on submarine cables in connection with the 'siphon recorder' and 'mirror' systems." T. J. WILMOT. Dated June 15.

8765. "Improvements in holders for incandescent electric lamps." W. ROWBOTHAM and W. FOX. Dated June 15.

8772. "Improvements in electrical switches." W. ROWBOTHAM and W. FOX. Dated June 15.

8784. "Improvements in systems of electrical supply." F. V. ANDERSEN and J. F. TAFE. Dated June 15.

8814. "A new or improved magazine small-arm discharged by electricity, and cartridges for the same." A. TREEBY. Dated June 15.

8836. "Improved safety electrical switch and fuse box combined." G. J. PHILPOTT and G. H. ALDERTON. Dated June 16.

8864. "An electric tell tale or counter mechanism." D. A. AIRD. Dated June 16.

8871. "Improvements in electrical switches, commonly called electric bell pushes or presses." J. I. RYDER. Dated June 18.

8912. "An electric meter for registering or recording electricity." H. RAISON. Dated June 18.

8919. "A new or improved type of electric cable, specially applicable for high tension alternating currents, and methods of, and apparatus for, manufacturing the same." J. G. LORRAIN. (Communicated by La Société d'Exploitation des Câbles Electriques, système Berthoud-Borel et Compagnie, Switzerland.) Dated June 18.

8920. "A new or improved type of electric cable, specially applicable to long distance underground and submarine telephony." J. G. LORRAIN. (Communicated by La Société d'Exploitation des Câbles Electriques, système Berthoud-Borel et Compagnie, Switzerland.) Dated June 18.

8950. "Improvements in applying electrical traction to pleasure, sporting, and business purposes." C. B. BURDON. Dated June 19.

8966. "Improvements connected with or applicable to baths or vessels containing liquids used in electro-plating, or dyeing, or the electrolyte of storage batteries and the like." E. HOPKINSON and D. APPLETON. Dated June 19.

9005. "Improvements in dynamo-electric machines." F. WYNNE. Dated June 20.

9046. "Improvements in magneto-electric bells." E. COX-WALKER and A. A. C. SWINTON. Dated June 21.

9141. "A new or improved automatic electrifying apparatus." C. HUELSER. (Communicated by J. Müller, Germany.) Dated June 22.

9206. "Improvements in galvanic elements or batteries." C. LUTCKE and P. GEORGE. Dated June 23. (*Complete.*)

9224. "Improvements in the distribution of electric currents from central stations." G. HOOKHAM and R. H. HOUSMAN. Dated June 25.

9254. "Controlling devices operated by means of the thermic effects of electric currents." R. M. DRAKE, J. M. GORHAM, E. MANVILLE and W. L. MADGEN. Dated June 25.

9308. "Improvements relating to dynamo-electric machines." J. EDMONDSON. Dated June 26.

9332. "Improvements in electrical connection of railroad rails." F. STITZEL and C. WEINEDEL. Dated June 26. (*Complete.*)

9333. "Improvements in and relating to electric arc lamps or lighting apparatus." H. PIDOT and H. PAUTIER. Dated June 26.

9381. "Improvements in electric batteries." A. IMSCHENETZKY. Dated June 27.

9405. "A method to enable alternating currents of electricity to be utilised for charging electrical accumulators." R. F. YORKE. Dated June 28.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

6682. "Improvements in and connected with electrical distribution by means of direct or alternating currents, chiefly for lighting purposes, and in electric measuring instruments which may be used therewith." J. SWINBURNE. Dated May 6. 11d. The primary circuits of the converters are arranged in series, so that what may be called a constant alternating current is used in the primary circuit. The secondary circuit of each converter is connected to incandescent lamps, but these are arranged in series, not in parallel. Each lamp is provided with a short circuiting switch which is used to turn it out. Thus when all the lamps are turned out the secondary circuit is short-circuited. The claims are 15 in number.

6987. "Improvements in electric arc lamps." A. SIEMENS. Dated May 12. 8d. Claims:—1. An electric arc lamp wherein the carbon holders are mounted upon two screwed rods geared together, so that by rotating in contrary directions they cause the carbon holders to approach each other, the one rod having a step by step rotary motion imparted to it by means of a break strap and lever, controlled by a spring and by the armature of an electro-magnet, through the coils of which a shunt current from the lamp circuit is made to pass, the several parts being arranged and operating as described. 2. In an electric arc lamp arranged and operating as set forth in the preceding claim, so arranging the armature of the electro-magnet in the shunt circuit, that when it is drawn away by the spring, owing to the shunt current being too weak to cause the electro-magnet to attract it, it makes a contact so as to close the shunt circuit, but when it is attracted by the electro-magnet, owing to an increase in the shunt circuit, it breaks the shunt circuit, and thus renders the electro-magnet inoperative again, substantially as described. 3. In electric arc lamps the combination of the screwed rods, toothed wheels, brake strap, lever, adjustable spring, armature, with contact and electro-magnet in a shunt circuit of the lamp, arranged and operating substantially as described with reference to the drawings.

7078. "Improvements in electrical indicators for showing the rise and fall of gas-holders and the quantity of gas therein, or water in reservoirs and the quantity therein, and for other similar purposes." P. WILLIAMS and W. POWLES. Dated May 14. 8d. Claims:—1. The apparatus for transmitting along one line wire electrical currents in opposite directions in accordance with the rise or fall of gas-holders or direction of motion of fluids, substantially as described with reference to the drawings. 2. The long arm controlled by tumbler working in cam for making long contact, as described. 3. The jockey piece rocking from one plate to the other and keeping line wire always to one pole of the battery, as described. 4. The use of moving drums for showing a number of figures, as described. 5. The combination of the transmitting and the recording apparatus constructed, arranged, and operated, substantially as and for the purposes described.

7184. "Improvements in electric arc lamps." W. MACKIE. Dated May 17. 8d. The inventor constructs the lamp so that the main coil is not a fixture, but is free to move in such a position that it shall be capable of striking an arc and then affixing itself on to the core of the shunt solenoid. The action of the shunt solenoid core will then be to return the main coil to its original feeding position. This solenoid coil, having an iron button fixed in one end, is suspended over its own core to a sufficient distance to enable it on its coming down to strike the necessary length of arc. This main solenoid core is attached to the core of the shunt solenoid, having a dash-pot between the two; the total weight of these cores and dash-pot being greater than that necessary to strike the arc, they will remain stationary until the shunt coil becomes of sufficient strength to lift them, which it will continue to do until it has returned the main coil to its feeding position. If it overfeeds, the system of cores will fall and open out the arc again. The claims are 4 in number.

7317. "Improvements in secondary electric batteries." J. KYNOCH and W. HABGOOD. Dated May 19. 4d. Claims:—1. In the manufacture of peroxide of lead elements, the production of a hard and coherent plate or mass, by making a suitable acid or salt, separately or together, act chemically on one or more of the oxides of lead, in such a manner as to peroxidise it (or them) and cause it (or them) to become hard and coherent. 2. The mixing of plumbago with the oxide or oxides of lead used in making the peroxide element.

7426. "An improved process for the preparation of aluminium, aluminium bronze, and alloys of aluminium by electrolysis." A. C. HENDERSON. (Communication from abroad by P. L. Héroult.) Dated May 21. 8d. Consists in decomposing alumina in solution in a bath of molten cryolite by means of an electric current reaching the bath, on the one hand, through the medium of an electrode in contact with the crucible of agglomerated carbon containing the cryolite, and on the other hand, by means of another electrode, also made of agglomerated carbon like the first and dipping into the bath. The claims are 7 in number.

7548. "Improved method of transmission through submarine cables and apparatus therefor." J. GOTT. Dated May 25. 8d. Claims:—1. A self-acting device by which currents of an opposite polarity are sent into a telegraph cable after the main signal current is sent, and the signal current may be of any duration. This device automatically connects the cable to earth after the reverse current has been sufficiently prolonged to neutralise or partially neutralise the main signal current in the manner described. 2. The combination described of an electromagnet relay a polarised differential relay and two hand keys so connected that the two relays are simultaneously actuated by the same pole of the local battery, whichever key is depressed, in order to more effectually accomplish the object aimed at, namely to send automatically and with perfect regularity reverse currents after each signal current.

7950. "Improvements in or connected with telephones for indicating and recording the number of times that a telephonic instrument is used, for ascertaining payments due, or for other purposes." D. J. SMITH and H. F. JACKSON. Dated June 1. 8d. The inventors provide each set of telephonic instruments with a counter, and a button or device with a rod stem or part, which each time the said button or device is operated moves the counter on one unit. The said button or device will also, by a preconcerted signal, indicate to the operator at the exchange or other place that the instrument has been used. This is effected by causing the rod, or device, in connection with the button or the like to make and break contact between springs, or contacts forming part of the primary circuit of a transmitter or otherwise (which may be a special transmitter or the one usually provided in the set of instruments). Or the indication to the operator may be made by a vibrating piece or wheel released by the movement of the calling button, or the like. The claims are 5 in number.

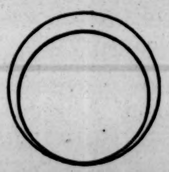
7982. "Improvements in or additions to telephonic instruments for enabling them to be used only on prepayment for such use." C. L. W. FITZGERALD. Dated June 2. 11d. The inventor fits, preferably within the case of the telephonic instrument, a receptacle for a coin (or coins) which is utilised as the means for completing the communicating circuit of the instrument. After the insertion of the coin, the user of the instrument can communicate with the exchange or other place in the line. In proximity to a movable part of the receptacle is arranged an electromagnet which can be magnetised by a current from the exchange or distant station so that it attracts an armature in connection with the said movable part and releases the coin and breaks the circuit and prevents further use of the telephone until another coin is placed in the instrument. The slit for the entry of the coin and the outlet therefor from the receptacle can be made of such size that the one admits only coins of the proper thickness and the other retains only coins of the proper diameter. The claims are 4 in number.

10963. "Improvements in instruments for the measurement of electromotive force and power." J. A. FLEMING. and C. H. GIMINGHAM. Dated August 10. 11d. Relates to the apparatus mentioned in the No. of the REVIEW for January 20th, 1888.

CORRESPONDENCE.

Protecting Underground Conductors.

Referring to the advantages of iron over lead, besides cheapness and greater strength wrought iron is free from pores. In coiling and uncoiling lead you are liable to open pores; as lead tubing is coiled the outer surface of the tube forming the circle is elongated and the inner surface compressed, and this condition is produced by the comparatively rigid nature of the cable or conductors inside. If the insulation consists of paraffin, and moisture reaches the paraffin, which is all broken up by the coiling and uncoiling, the moisture goes directly to the conductors. If it goes to the mixture of rosin and rosin oil, it stops there, provided it does not reach the textile covering. In that case, if it finally penetrates the covering and reduces the insulation, wire after wire will fail. Wrought iron pipe is rigid and has no pores, being proved under a hydraulic pressure of from 1,000 to 2,000 pounds to the square inch. The socket-joints are moisture proof by the use of a cement of white lead and linseed oil; but supposing the socket-joints are not perfectly moisture proof, the insulating material is poured directly into the socket at a temperature of 400° Fah. and fills all apertures, and on cooling will remain and prevent all ingress of moisture. When lead is drawn over a cable the textile covering comes directly in contact with the lead, and the pores opened in the lead admit moisture to the textile covering, thereby causing the insulation to fail. In iron pipes the position of the cable is shown by the figure, the outer circle representing the pipe, and the inner circle that of the cable, the space between the two circles is filled with the insulating mixture, which is heavier than water, and, being semi-fluid, does not crack or check at a temperature below freezing. It will be seen that the chances of moisture reaching the cable are exceedingly remote.



Lead-encased cables are very little used in this country, except for telephonic purposes, and then only for short distances, seldom over a mile. Telephones can be worked for that distance with very low insulation. To remedy the difficulty—porosity of the lead—they are sometimes laid in a trough and covered with pitch.

Félten and Guilleaume cover the cable with a braid saturated with bitumen; Berthoud-Borel draw on one covering of lead, cover that with an insulating material, and over that draw a second lead covering.

Comparative cost. A lead cable one inch inside diameter of the weight usually used in this country, costs 12 cents per foot or upwards. An iron pipe lap-welded, 2¼ inches diameter, suitable for the purpose, can be had at 12 cents per foot. The capacity of the iron pipe is over six times that of the lead, and can be made to contain six times as many conductors with the same amount of covering or insulation, or we can give the conductors six times the insulation and less than one-sixth the electrostatic capacity. Iron pipe in England is 40 to 50 per cent. cheaper than in this country, while the prices of lead in the two countries are very nearly the same. It is a very easy matter to make an electric light conductor show an insulation of from 5,000 to 20,000 megohms per mile, and at trifling expense as compared with ordinary modes of insulation.

The cable that I laid a year ago of this new system shows higher insulation at this time than when first laid. I can say at even temperature it is more than twice as high. [We are looking out for an European agent—don't all speak at once!] I trust the editor will not erase the foregoing sentence; he can include it in brackets, aud use very small type if he chooses.

David Brooks.

Philadelphia, *June 22nd*, 1888.

Electric Traction on the Underground Railway.

The proposal to work the Underground Railway by means of electric locomotives and accumulators must strike every one who knows anything about the subject as simply ridiculous, and it is difficult to believe that any electrical engineer ever seriously entertained such a project. One would not now be surprised if this brilliant proposal was followed by another from the same quarter offering to run the whole fleet of Atlantic "liners" by means of accumulators. Should it not first be shown that the accumulator cars on the Barking Road tramline can be run profitably at 4½ per car mile, or was it from the miserable performances of these cars on the Brighton and Shoreham tramways that such confidence in the accumulator for electric traction was gained? Let us have ample proof that a *tramway* can be worked efficiently, and at a moderate cost, by means of accumulators, before we are expected to believe in their successful employment for such a stupendous undertaking. So far, all attempts at electric traction by accumulators has only proved that they are, in their present condition, totally unfitted for such work.

It is quite obvious, however, that the Underground Railway is eminently adapted for working on the direct system. Here we have not the difficulties to contend with that are experienced in a street tramway. The public having no access to the permanent way, the conductors, instead of having to be placed in an expensive, damp, and in the majority of cases inaccessible subterranean conduit, can easily, and at no great expense, be fixed overhead, or supported up from the ground, as at Bessbrook and Portrush, on well insulated supports. A short length of conductor could easily be laid down without in any way interfering with the present system of locomotion. The Bessbrook and Newry Railway has shown at what figure the working expenses might be expected to work out at, and it is patent to everyone that, whatever the cost of working by accumulators, it could always be done considerably less on the direct system.

F. C. Allsop.

July 2nd, 1888.

Comparing Very Unequal Capacities.

In your last issue occurs a short account of Mr. Fison's paper, read before the Physical Society, on "A method of comparing very unequal capacities."

The formula given is $\frac{R_{AB}}{R_{BC}} = \left(1 + \frac{C_2}{C_1}\right)^n$

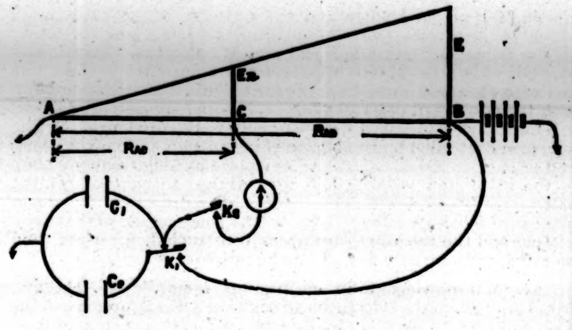
This appears to me to be incorrect. It should be

$$\frac{R_{AB} - R_{BC}}{R_{AB}} = \left(1 + \frac{C_2}{C_1}\right)^n$$

or calling $R_{AB} - R_{BC} = R_{AC}$ it should be

$$\frac{R_{AC}}{R_{AB}} = \left(1 + \frac{C_2}{C_1}\right)^n$$

I append a short proof:



Let E = the P.D. between A and B.
E_n = the P.D. between A and C.
R_{AC} is the resistance adjusted so that E_n = the P.D. of the condensers after depressing and releasing K_1 "*n*" times.
C_2 is the capacity of the small condenser.
C_1 is the capacity of the large condenser.
R_{AB} is the resistance between A and B.

On depressing K_1 condenser C_2 will be charged with a quantity $Q = E\,C_2$.

Let up K_1. The quantity, Q, then divides between C_1 and C_2. Let the P.D. of condenser plates become E_1, then

$$Q = E\,C_2 = E_1\,(C_1 + C_2) \therefore E_1 = E\left(1 + \frac{C_2}{C_1}\right)$$

Depress K_1 a second time. C_2 is again charged with a quantity $Q = E\,C_2$. There is also a charge q on $C_1 = E_1\,(C_1 + C_2)\,\frac{C_2}{C_1}$. When K_1 is released these charges mix.

Let the P.D. of the condenser plates now become E_2. The sum of the charges on C_1 and C_2

$$Q + q = E_2\,(C_1 + C_2) = E\,C_2 + E_1\,(C_1 + C_2)\,\frac{C_2}{C_1}.$$

Now,
$$E_1 = E\left(1 + \frac{C_2}{C_1}\right)$$

$$\therefore E_2\,(C_1 + C_2) = E\,C_2 + E\left\{\left(1 + \frac{C_2}{C_1}\right)(C_1 + C_2)\left(\frac{C_2}{C_1}\right)\right\}$$

$$E_2 = \frac{E\,C_2}{C_1 + C_2} + E\left\{\left(1 + \frac{C_2}{C_1}\right)\frac{C_2}{C_1}\right\}$$

$$= E\,\frac{C_2^2 + 2\,C_1\,C_2 + C_1^2}{C_1^2} = E\left(\frac{C_2}{C_1} + 1\right)^2$$

In the same way it may be shown that after "*n*" operations

$$E_n = E\left(1 + \frac{C_2}{C_1}\right)^n$$

Now,
$$\frac{E_n}{E} = \frac{R_{AC}}{R_{AB}} = \left(1 + \frac{C_2}{C_1}\right)^n$$

A. Annesley Voysey.

Weymersch Depolariser.

I am sorry that you cannot give the promised information, but trust that you may be able to do so at some future time, and that you will keep us informed through your columns of any commercial development of this undoubtedly very good depolariser, as I should like to give it a similar test to that which I gave the nitrate solution.

I think if you try the last mentioned under conditions similar to those under which you tested the Weymersch, that you will find the results very similar.

Your tests are always so thorough and the results so clear that the report would be valuable as showing the difference between the Weymersch and the cheapest and most constant depolariser at present known.

I am glad to see that I (or my battery which you favourably criticised at the time of its appearance) have a little corner in your memory.

Harry J. Barnett.

July 2nd, 1888.

Primary Batteries.

After perusing your remarks relative to the "Eclipse" Electric Lighting Syndicate, I thought that a short history of this so-called remarkable battery, prior to its introduction to the public, might either interest or amuse you.

About three years ago a gentleman residing at Montpelier, Bristol, amused himself by making various primary batteries. Thinking he could get better electrical contact with his carbon plates, otherwise than casting lead on the tops, he procured thin gold caps and took them to a neighbouring jeweller to have them fixed.

The jeweller immediately became interested in electrical phenomena, and set about making several pieces of apparatus, none of which were any good, but eventually he contrived to make a wooden box divided into four compartments, lined the inside with a compound (secret, of course, but closely resembling Chatterton's), hung zincs on copper hooks. put sodium nitrate with sulphuric acid and water in porous pots, finally covering the top with a tight-fitting lid with a valve in it (as he said) to prevent the hydrogen from escaping too fast. When complete this box had a very sepulchral appearance, and was launched forth as a great invention, under the title of "Electric Light and Power Battery."

Bristolians, however, did not quite see the joke, and would have nothing to do with it, and the great invention would probably, like the rose, have blushed unseen, had not a London financier (who was in Bristol on business) come to the rescue.

Several batteries were taken up to London, and an attempt to dispose of the whole patent rights to the New London Cab Company resulting in failure, a fresh attempt was made to form a company, and ye box was, with slight modifications and loud puffing, heralded forth in the great city as the "Eclipse" and *only* primary battery.

The only decided novelty about the thing was zincs hanging on copper hooks (local action being disregarded) and the valve to prevent hydrogen from escaping too freely. This must have been too much for some one who knew something about electricity, and doubtless it was named the "Eclipse" not from any merits, but from the absurdity of its construction. The actual depolariser used is not a patent, the only difficulty in making being right temperature when the sodium nitrate is added. Thus much for the great "Eclipse."

H. Everard Hunt,
Taunton E. L. Co.

[Our correspondent, to whom we tender our thanks for his trouble, has not added much to the information given in our columns from time to time, but his letter may be interesting to those who cannot refer to the back numbers of the REVIEW.—EDS. ELEC. REV.]

The Electric Lighting Bill.

We beg to enclose you copy of letter addressed by Lord Thurlow to the members of the Executive Committee of the Electric Lighting Act.

Anglo-American Brush Electric Light Corporation, Limited.
Per A. B. C.

July 3rd, 1888.

"Anglo-American Brush Electric Light
"Corporation, Limited,
"112, Belvedere Road, Lambeth, S.E.
"*June 26th*, 1888.

"Dear Sir,—In thanking you for the valuable support and assistance you have extended to me as Chairman of the Electric Lighting Act Committee, without which support it would have been useless for me to have attempted to move in the matter, it affords me great pleasure to inform you that the Bill amending the Act of 1882, framed on the lines recommended by your Committee, and introduced by me into the House of Lords this year, has now passed both Houses of Parliament without material modification, and only awaits the Royal Assent to become law.

"Under this Bill, forty-two years are substituted for twenty-one as the life of a Provisional Order, and ten years for seven for that of a license; more favourable conditions are also prescribed in the event of compulsory purchase by a local authority at the end of the term.

"I sincerely hope that this successful termination of our efforts during the last three years may render it possible to attract the necessary capital to enable the electric lighting industry to advance without further delay on its career of utility, beauty, and economy.

"My own opinion is that with the alterations in the Act now effected, and with good management, no reason exists why electric light undertakings should not now prove commercially and financially successful, and become a well-recognised investment for capital at least as profitable as gas shares, or other equally popular securities.

"With reference to our Committee, I should propose that it be not dissolved but continued in existence, so that it may from time to time be called together for deliberation and consultation, as occasion may require. On this point I shall be glad to have the benefit of your opinion.

"I remain, Yours faithfully,
"THURLOW."

The British Association of Medical Electricians.

It may be interesting to some of your readers to know that I have offered to meet "The Eminent Consulting Electrician," C. B. Harness, on any London platform or elsewhere, before a committee of scientific and medical men, to discuss the merits of his so-called "electropathic" belt. I have also promised to hand over to any charitable institution in London the sum of £50, if the "eminent" can *prove* by scientific demonstration that his belts contain all the electrical virtues claimed for them in his pamphlets and advertisements.

In September last, and several times since, I have received terrible threats of *immediate action for damages*, and an injunction to restrain me from using the words "Electropathy," "Electropathist," or "Electropathic," which the before-named gentleman claims as his absolute property, though used by me many years before the existence of the Medical Battery Company, or its parent, the Pall Mall Electric Association. However, much to my disappointment, the threats have not been put into execution, otherwise daylight might have been let into many of the proceedings of the Battery Company long before now.

By the aid of a friend of mine I have come into possession of a few facts relating to "The British Association of Medical Electricians."

You were perfectly right in your statement last week about the whole of the members named in the articles of association being composed of Mr. Harness's staff.

My friend paid 10s. 6d. for a copy of the articles of association, which I have forwarded to you, also copies of his last letter to the worthy secretary and his reply, by which you will notice on comparing with the articles that the object of the association seems to be to boycott anybody who attempts to enter the charmed circle; at least they have power to effectually do it.

I may say that some time ago I obtained an interview with Dr. Leeson, who is attached to the Battery Company as Medical Superintendent of the Electro-Massage Department, but is really another agent to encourage the sale of the infallible belt.

I had a long talk with this gentleman in his consulting room (the landing on the top of a flight of stairs), and can assure your readers that his knowledge of things electrical is quite on a par with the "eminent's."

I quite endorse Mr. Jerritt's suggestion about the circulation of a small pamphlet; and, in the event of a fund being started, I shall be glad to send a cheque for £5 for so desirable an object.

Apologising for taking so much of your space,

Robt. J. Parkes.

July 4th, 1888.

[This letter, together with the copy of the correspondence below, came to hand just as we were about going to press, but the "articles of association" have not yet reached us. It appears to us that Mr. H. C. R. Sharman, who seems very closely identified with the editor of a newly-started paper called *The English Home*, nominally a journal of social, religious (?) and general reading, but apparently run for the purpose of exploiting the Harness apparatus, and to which we referred a few weeks ago in vigorous if uncomplimentary terms, is making a very warm corner for himself. The sooner some decided course of action is taken by the medical profession to put an effective stop to the kind of business Mr. Sharman and his confederates are engaged in, the better it will be for the profession and for the public.—EDS. ELEC. REV.]

[COPY.]

2, Maple Street, Southport,
June 18th, 1888.

Dear Sir,—Will you please forward to above address prospectus of "The British Association of Medical Electricians" and terms of membership, as I am desirous of joining the society if I find it commends itself to my judgment.

Yours faithfully,
(Signed) JAMES STANGER.

[COPY.]

The British Association of Medical Electricians,
Registered Office, 39, Hatton Garden,
London, E.C., *June 20th*, 1888.

Dear Sir,—In reply to your letter of the 18th inst., I beg to inform you that you can obtain a copy of our bye-laws and articles of association by remitting 10s. 6d. to me at the above address.

Yours obediently,
(Signed) H. C. R. SHARMAN, *Secretary*.

Mr. J. Stanger, 2, Maple Street, Southport.

[COPY.]

2, Maple Street, Southport,
June 25th, 1888.

Dear Sir,—I have carefully perused the "articles of association of the British Medical Electricians," but before becoming a member on the terms laid down therein, I shall be glad if you will forward me a list of names and addresses of the subscribers who have joined the society since the publication of the prospectus, that I may form a judgment as to its present position.

Yours faithfully,
(Signed) JAMES STANGER.

[COPY.]

The British Association of Medical Electricians,
Registered Office, 39, Hatton Garden,
London, E.C., *June 27th*, 1888.

Dear Sir,—I am obliged for your favour of the 25th inst, but as you are a total stranger and appear to have no interest in common with the objects of this association, I regret I cannot see my way to give you any further information. You have a copy of the bye-laws and articles of association from which you can ascertain the qualifications necessary for membership.

Yours obediently,
(Signed) H. C. R. SHARMAN, *Secretary*.

Mr. J. Stanger, 2, Maple Street, Southport.

Mr. C. B. Harness, "the eminent medical electrician!!!" has objected to my use of the word "Electropathic," stating that this is his trade mark, and that he coined it. The following is a quotation from his pamphlet:—"Mr. Harness adopted the word 'electropathic' as his trade mark, which word was a new one in the English vocabulary, and is particularly expressive, and absolutely the property of Mr. Harness, no other person can legally use it in relation to electrical belts, appliances, or treatment." Of course I know that this is all humbug and bounce; nevertheless, can you inform me how long the word has been in use? If it is a "trade mark," it would not stand good in a court of law, as the word is a descriptive one, and not in any sense a "fancy word;" indeed, if any one took the trouble he could have it removed from the Trade Mark Register.

W. Johnson, R.S.C.

July 3rd, 1888.

[Dr. Parkes, of the Electropathic Establishment, Southport, states that he used the words "electropathy," "electropathic," and "electropathist" years before the supposed registration of one of these terms by the president of the British Association of Medical Electricians, and he has printed matter to prove the employment of the above expressions in 1881. The gentleman mentioned has also discovered that the particular word in question has been in use in one instance for over 20 years.—EDS. ELEC. REV.]

My attention has been drawn to an editorial paragraph appearing in your last week's issue (page 690). The statements contained therein are so ridiculous that it seems superfluous for me to comment on them at all.

I am pleased to note, however, that you "do not vouch for the accuracy" of your remarks, which are *entirely* incorrect. It is evident that your "correspondent" must have a personal spite against Mr. Harness, and because he has been elected our president, you have been prevailed upon to attack our association.

Perhaps you will be good enough to insert this letter in your next issue, in case any of your readers should have believed the false statements contained in the paragraph referred to.

H. C. R. Sharman, *Secretary.*

July 3rd, 1888.

[We willingly insert Mr. Sharman's letter, because it seems to strengthen our remarks of last week. He gives us no proof whatever that our statements were either ridiculous or incorrect. Perhaps he will favour us with a complete list of the Council of the British Association of Medical Electricians, together with all particulars of the objects sought to be attained by the Association. This must be sent to us gratis, as we have no half-guineas to throw away.—EDS. ELEC. REV.]

Electrical Quacks and Galvanic Belts.

With the object of exterminating electrical quacks and galvanic belt frauds, a subscription list has been started in order to publish in pamphlet form the excellent report and a portion of the correspondence on the above subject which has recently appeared in the columns of the ELECTRICAL REVIEW. A committee is being formed in order to carry out this benevolent scheme effectually. I shall be thankful to receive assistance in any way from any of your readers.

J. Jerritt, A.S.T.E. & E.
Secretary pro tem.

Mutley, Plymouth,
July 3rd, 1888.